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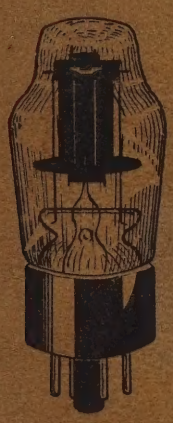
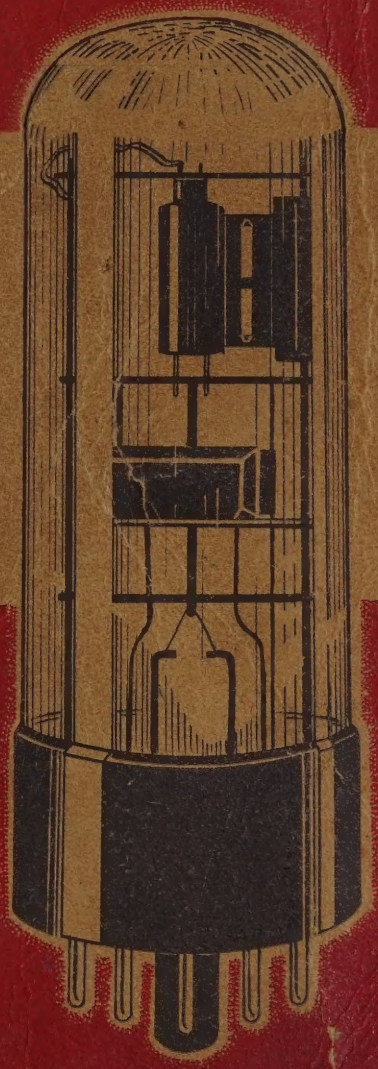
# RECEIVING TUBE SUBSTITUTION GUIDE BOOK





BY H. A. MIDDLETON

FIRST EDITION

# RECEIVING TUBE SUBSTITUTION GUIDE BOOK

BY

H. A. MIDDLETON

FIRST EDITION

JOHN F. RIDER PUBLISHER, INC.
480 CANAL STREET NEW YORK 13, N. Y.

RIDER MANUALS

# NEW ENGLAND TELEVISION CO.

ELECTRONIC RESEARCH LABORATORIES

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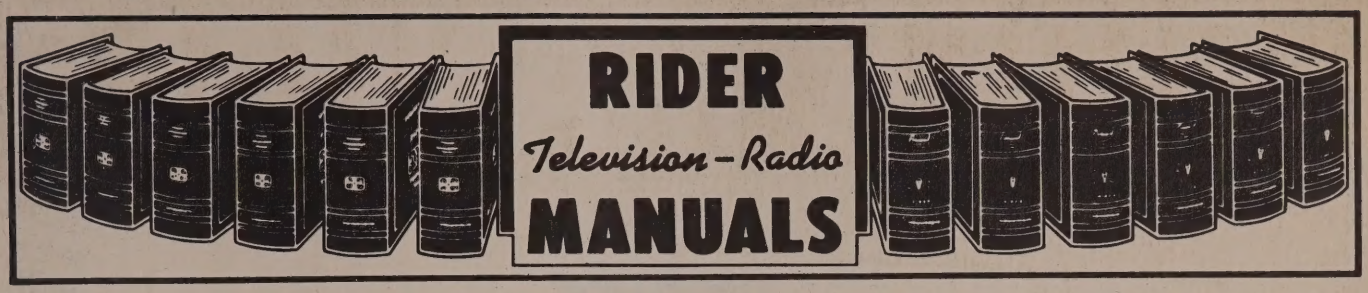


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# FOREWORD

*Receiving Tube Substitution Guide Book* is a greatly enlarged and revised edition of the book *Wartime Radio Service* published in 1944. This new book lists about 750 receiving tube types and their bases, including all of the following series:

4, 5, 6, 7, and 7L old-style base series
Octal base series
Loctal base series
7-pin miniature series
9-pin-noval series
Subminiature series.

During the past eight years we have made many tube substitutions. Most of them were easy to make and all resulted in from excellent to reasonable performance. The majority of substitutions shown here have actually been tried. We are passing this information on to you in the belief that it will save you many hours and enable you to make necessary repairs to electronic equipment in spite of shortages. Also, when shortages no longer exist, you will again save time in restoring equipment to its original condition after substitutions have been made.

All substitutions listed here describe in detail the necessary data for changing or rewiring the sockets. It is recommended that in making the circuit changes listed you follow the sequence exactly as indicated in order to avoid any errors in rewiring.

You will note that a few types have no substitutes listed. We do not presume to be infallible. We may have omitted some tube substitutions. If you know of tube substitutions which have been omitted we would like to hear from you about them.

Besides a tube substitution listing we have included other important information that will make this book even more useful as a substitution guide. In Section 3 we offer a compilation of television receiver filament circuit arrangements including various filament diagrams. These were compiled by John F. Rider Publisher, Inc., to whom we owe thanks for their contribution. The information was taken from the five presently existing Rider TV Manuals. It is hoped that this information will not only aid tube substitution operations, but will prove helpful in connection with TV servicing in the home. A group of servicing suggestions are also included to help in repairing the filaments of burned-out tubes, making adapters, and for the change over of battery-operated radios to electric operation.

Most significant is the last section of this book which covers different charts and tables. A complete listing of the characteristics of receiving tubes and bases and cathode-ray tubes and bases are included in this section. Thus this book, besides serving as a tube substitution guide, also functions as a tube handbook.

We wish to express our appreciation to the American Radio Relay League for their cooperation in permitting us to reprint their receiving tube characteristics charts from their ARRL handbook. In our estimation these are the most complete charts available at this time. To Tung-Sol Lamp Works, Inc., for supplying us with the data on tube classifications, ballast tube and resistor numbering codes, and RTMA resistor, capacitor, and transformer color codes our thanks; also to Sylvania Electric Products, Inc., for supplying us with the data on cathode-ray-tube characteristics; to Federal Telephone and Radio Corp. and Radio Receptor Corp. for their kind cooperation.

November, 1950

H. A. MIDDLETON

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# SECTION 1

## THE BACKGROUND OF TUBE SUBSTITUTIONS

Were it not for the fact that tube development is a never-ending activity, there would be no purpose in describing the background of tube substitution. The substitution lists contained herein would suffice, for they include practically every tube which is used for receiving purposes serving many different electronic applications. These applications consist of radio receivers of all varieties (a-m, f-m, and TV), radar, facsimile (commercial and military), public address amplifiers, record changer amplifiers, test equipment, electronic computers — in fact every kind of equipment with the exception of transmitters, although even there, receiving tubes make their appearance in the speech amplifiers.

The basis of tube substitution is *similarity* or equivalence between the original and the substitute. The choice of these two words with different connotation is deliberate; similarity may mean equivalence in some respects but not in all. Thus if two tubes are similar (or identical) in electrical characteristics, one is the equivalent of the other. The use of two tubes, however, to replace one single tube which affords certain facilities, creates a state of equivalence rather than a state of similarity.

This is not intended as a play on words but deals with a very important situation that is developing fast in television receivers. Unwelcome as it may be, it means constructional modifications and even more important, a careful analysis of what suits the purpose. Any attempt to list all the substitutes within the meaning of equivalent as we have described it, would be a monumental task and would more than likely, never see the light of day. We hope, therefore, that the general details of the background of tube substitution given in this section combined with the tube substitution lists and the knowledge possessed by the technician who makes the change (and selects the substitutes) will result in satisfactory substitutions.

An examination of the tube substitution lists will disclose that the substitution of one type for another is not too frequently accomplished by a simple replacement of tubes. Differences in tube characteristics may demand some modifications in the circuit within the apparatus. Sometimes, only a change of socket is needed because of differences in the basing of the substitute tube. In other instances, definite restrictions are imposed relative to the heater circuits; some substitute tubes may be used only in parallel-wired heaters without any circuit changes, whereas in other instances, a tube substitution is applicable only to series-wired heaters. In some cases, a tube substitution may demand modifications in the cathode, control grid, plate, or screen circuits, or possibly in the power supply, so as to satisfy the needs of the substitute and accomplish the best possible performance. These circuit changes are not listed because they are peculiar to each system.

All of this means that although the lists in this Guide Book give the substitute or substitutes as the case may be, the final selection cannot be made without considering the conditions existing in the equipment which will receive the substitute. Where changes in heater or filament wiring are required, they are described. Changes necessary in the signal electrode circuits such as those of the control grid, screen grid, cathode, and plate so as to attain best possible performance become the function of the technician and are determined by the constants of the specific circuit in which the substitution is made.

As shown in the three series of Rider's Manuals (AM-FM, TV, and PA), many tens of thousands of models of receivers and amplifiers comprise the hundred odd million units which may require substitute tubes.

Fortunately, a certain amount of standardization does exist in receivers and other equipment designed to work with the tubes listed herein. This situation, together with the circuit and operating voltage details given in the above-mentioned manuals and manufacturers' literature affords the technician the opportunity of determining the operating conditions thereby enabling him to establish the correct voltages at the different signal electrodes. A familiarity with these techniques is not difficult to acquire, although we hasten to add that too many differences exist to permit circuit modifications based on guesswork or memory. Schematic wiring diagrams, operating voltage tables, and the tube characteristic charts demand attention if longest tube and component life are desired, and also, if best circuit performance is to be attained with the substitute tube.

Design engineers have their own ways of accomplishing performance with the standard run of tubes. Many substitutes are possible but all will not afford like performance. In listing the substitutions, only those sub-

stitutions considered practical, that is, which do not demand redesigning of circuits, were included. Many substitutes possess sufficient similarity to the original as to require no changes in either heater wiring or sockets. These are listed with the note "No changes." This does not mean, however, that the signal electrode operating conditions are identical for the original and the substitute. This should be checked in the tube characteristics chart contained in this Guide Book. It only requires a few minutes of time to do this and its results can be very gratifying.

If upon examination, the differences in electrical characteristics between the recommended substitute and the original are more than moderate, changes in the signal electrode operating circuits may be required. Since the plate voltage requirements for tubes in similar categories do not differ greatly, changes are not too frequent in the plate circuits. It is only when battery type and a-c operated tubes are being compared that one finds radical differences in plate and screen voltages. More critical points are the control grid and cathode bias — especially the latter. Small numerical differences in bias voltages (which are related to the plate current) produce great performance differences. For example, a change in bias from —2 volts to —4 volts is only 2 volts, but it represents a change of 100 per cent, and can very materially influence performance. A situation of this kind would demand a change in the value of the bias resistance.

A bias tube may be listed as the substitute for a zero bias tube. Reference to the electrical characteristics will disclose that the grid resistor must be changed; sometimes from 10 megohms to as low as 0.25 megohm. In addition, a cathode resistor of such ohmic value as will develop the bias shown in the tube characteristic chart must be added. Thus, the statement "No changes," does not refer to signal electrode operating conditions, rather to the fact that neither heater wiring nor socket changes are required.

Each substitution is an individual case requiring individual consideration, unless it is definitely known that the original and the substitute are identical in all respects other than heater voltage. Even then, if the substitution is made in a system which involves a state of resonance, realignment will be required. Similar tubes, even identical ones, do not possess identical values of interelectrode capacitance. This difference affects the final value of tuning capacitance. It is very important to bear this in mind when substitutions are made in wideband amplifiers particularly, since here, the interelectrode capacitance (direct and reflected) plays a paramount role in the peaking action. Examples are the video amplifiers in television receivers and the amplifiers in oscilloscopes and the like. In making substitutions it is often necessary to consider the function of the tube and its circuit so as to insure best performance in the circuit. The various types of circuits and functions will now be discussed.

## Oscillator Systems

These may be heterodyning arrangements which involve tracking with other tuned circuits, such as in converter systems and separate oscillator and mixer circuits, or nontracking arrangements, such as beat-frequency oscillators. Also, there are the various kinds of multivibrator systems in television receivers. Each of these demands individual consideration.

Combination oscillators and mixers (converters) require substitutes which contain not only the identical number of electrodes as the original, but in addition, the functions of these electrodes must be the same. This immediately limits the number of possible substitutes. The list of tubes, classified by function found at the end of this section, is an aid in this respect. If the required substitutes can not be procured, it does not make sense to redesign the circuit so as to replace a single tube with two individual tubes. That is a design engineer's job. If the oscillator and mixer functions are performed by individual tubes in separate envelopes, then the latitude of substitution is greater, provided that the selection of the substitute tube is made carefully.

The higher the frequency of operation, the more critical is the choice. That is why new tubes are born as operating frequencies increase. Tubes designed for the broadcast band are frequently unsuited for use in the vhf band and most certainly not in the uhf band. Thus, in addition to recognizing the oscillator function, it is also imperative to pay heed to the frequency of operation. If a choice is available, the tube intended for a higher frequency is suitable for a lower frequency, but not vice versa with complete freedom.

Sometimes tubes specifically intended for use as oscillators will not perform properly in that position, it is difficult to account for this, but it is a fact nevertheless. This does not condemn the tube as a tube — it can still perform other functions — nor does it mean that another tube of like brand and type will behave in similar fashion. There is no remedy for such failure to function properly — it is simply a statement of fact.

What should be examined when comparing tubes intended for oscillators? Neglecting heater or filament ratings for the moment, these being assumed to be suitable and assuming that the number of circuit electrodes of the substitute original are the same, such details as the grid bias, the plate (and screen) voltages, the plate (and screen) currents, and the transconductance are paramount factors. If the exact duplicate is not available, the substitute tube which requires lower plate and screen voltages (differing only moderately from the original) is preferable to the substitute tube which requires higher plate (and screen) voltages than the original. The tube with the higher transconductance is preferable to the tube with the lower transconductance, everything else being equal. These preferences are more apt to furnish heterodyning voltage

over the entire band embraced by the receiver, especially if the bias resistor is modified to suit the specifications of the substitute.

## R-F and I-F Amplifiers

The general run of r-f and i-f amplifiers utilize tetrodes and pentodes. Since pentodes used as triodes (in a-f amplifiers) are substitutes for triodes, it is important when selecting a substitute to know the manner in which the tube is used in the r-f or i-f amplifier. A triode is a poor substitute for a pentode; if a pentode is used, the substitute should be a pentode. However, if a tetrode is used, the substitute may be either a tetrode or a pentode. Care should be exercised to note if a shield is a part of the tube. An unshielded tube may be substituted for a shielded tube provided that an external shield is used and is grounded properly. Single-ended tubes may be substituted for double-ended tubes, but the reverse may be troublesome. Care must be exercised relative to the control-grid lead dress so as to minimize regeneration.

Sharp cutoff tubes should be replaced by similar tubes; similarly with remote cutoff tubes. However, sharp cutoff tubes may be replaced by remote cutoff types without too much trouble. The avc may be affected somewhat, but this does not interfere with the effectiveness of the receiver. When sharp cutoff tubes replace remote cutoff types, however, some minor problems may arise. Their best location would be in places where the signal level is lowest, for example, in the first stage in either an r-f or i-f amplifier. If distortion is severe on loud signals (due to rectification in the sharp cutoff stage), a divider network may be required so as to reduce the avc bias being applied to the sharp cutoff tube. This is best accomplished at the source of the avc, and might call for a separate avc line to the sharp cutoff tube. It might even be satisfactory to operate the sharp cutoff tube (if it is located at the point of lowest signal level in the amplifier) without any avc, using a low fixed bias.

Where there is a high input signal, sharp cutoff tubes must be used in place of remote cutoff tubes, an auxiliary volume control (or divider) at the front end of the receiver (perhaps in the antenna circuit) may be required. This would be operated only on those channels which cause trouble. A panel switch would control the operation of this signal control element.

Transconductance is the important electrical characteristic to consider in r-f and i-f amplifier substitutions. The higher the mutual conductance is relative to an r-f or i-f transformer the better, assuming that the plate and screen voltage conditions are satisfied or approached. Inability to equal the original tube in transconductance means reduced gain in the stage, but this seldom is a problem in a-m or f-m receivers because the average receiver has excess gain for the reception of chain or local broadcasts. The same can be said about television receivers, provided that the receiver is located in a primary service area. When such a receiver is relatively close to a station, the problem is too much rather than insufficient signal, so that a reduction in r-f or i-f amplification (unless it is too severe) usually can be tolerated. In fringe areas, the situation is different, especially when the received signal levels already border on the inadequate. There it becomes necessary to approach the original, and if this cannot be attained, then it is preferable to select tubes with higher than the original transconductance and to adjust the operating voltages accordingly. General instructions of this kind are given elsewhere in this section.

Where r-f and i-f systems are subject to tube substitutions, realignment of the coupling transformers associated with the input and output circuits of the substitute stage are imperative. Sometimes it may appear that proper performance is being secured without realignment. This should not be accepted as fact without a test to establish if the circuits are peaked properly.

Whether the shift in frequency peaking is upward or downward depends upon the direction of the capacitance change. A reduction in distributed capacitance, which includes the plate-to-cathode (or control grid-to-cathode) capacitance tends to cause peaking at a higher frequency, whereas an increase in distributed capacitance tends to cause peaking at a lower frequency.

Many i-f transformers and some r-f transformers are permeability tuned, utilizing the related distributed capacitance including the tube capacitance to provide the *C* for the tuned circuit. Because of this, changes in distributed capacitance, due to different tube electrode capacitances, can cause major variations in operating conditions. Whenever possible, substitute tubes should approximate the input-output capacitance of the original tube. This data is found in the tube specification charts of Section 5.

Exception to the need for realignment of r-f and i-f coupling systems is found in those equipments which employ *R-C* coupling between tubes. While not a common practice, it is to be found in receivers. Sometimes the coupling element consists of a resistive plate load and a tuned grid load for the succeeding tube. The resistive plate load on a substitute tube requires no readjustment, but if the substitution is made in that stage which has a tuned grid load, realignment will be required. Examples of such arrangements are listed elsewhere in this section in connection with r-f and i-f transformer replacement.

## Audio Amplifiers

All types of tubes are found in audio amplifiers: triodes, tetrodes, pentodes, pentodes used as triodes, and various kinds of output-stage power amplifiers. Voltage amplifiers are, in the main, resistance-coupled

systems, whereas power amplifiers are transformer-coupled. The difference between these two general categories is the plate circuit load, that is, load impedance, and the grid bias.

There are some differences between the signal electrode operating conditions in resistance-coupled amplifiers, their operating voltage or load resistance may differ, but many substitutions are possible without changes. A fair degree of similarity exists between the fundamental designs of these circuits so that it is possible to generalize concerning substitutions. Pentodes can be used in place of triodes and, in turn, triodes may replace pentodes or tetrodes. The load resistances are pretty much the same for all of these tubes since the limitation is set by the plate voltage supply, and this does not differ too greatly in like categories of equipment. Naturally, the ideal condition is when the substitute is used exactly as the original, or the substitute type is the same as the original type.

In the case of triode-type tubes used in audio amplifiers, with the exception of the output stage, the amplification constant of the tube is the pertinent factor. The higher the amplification constant, the higher the stage gain, provided that the internal plate resistance is not too high relative to the load resistance. The higher the internal plate resistance of the tube, relative to the load resistance, the less the amount of signal taken out of the tube will be. The portion of the available signal taken out of the tube is expressed as

$$\frac{R_l}{R_p + R_l}$$

where $R_l$ is the load resistance in ohms and $R_p$ is the internal plate resistance expressed in ohms.

Another matter of concern to keep in mind is that relating to grid bias. Quite a few tubes used in *R-C* coupled amplifiers as well as in *L-C* coupled systems are of the zero-bias type. When adequate substitutes are not available and a self-bias tube is used in place of a zero-bias one, provision for the bias must be made in the circuit. This can be in the form of a bypassed cathode resistor. In addition, the grid resistor (grid leak) of the substituted stage will require reduction to perhaps one-thirtieth or one-fortieth of its original value. Zero-bias tubes utilize grid resistors of from 5 to 10 megohms. Self-bias amplifier tubes utilize grid resistors of from 0.1 to perhaps 0.3 megohms. These bias- and grid-resistor references will be found to apply to pentodes and tetrodes as well as triodes. When a zero-bias tube is used in place of a self-bias tube, the above-required changes in circuits are reversed.

In the output stages, for that matter, also in driver stages in audio amplifiers, attention must be paid to the recommended load impedance represented by the output transformer. Not only does it determine output power, which may or may not be important, but it also determines the quality of reproduction. The latter is important.

To begin with, the recommended load impedance for substitute tubes should be the *same* or *less* than that for the original. By being less than the original a fair semblance of the original quality will be retained because the tubes are working into a higher impedance, that represented by the output transformer already in the device. Power output will be reduced somewhat but quality of reproduction will be retained. If it is impossible to find substitutes which require the same, or a lower load impedance than the original, then a higher rating will have to be accepted, but it should be the closest approximation to the original.

A receiver installation can afford to sacrifice some power for quality. In public address systems, it is a question of how the system is used. If its full-rated power output is seldom used, then it can sacrifice some output for quality. If it is used for the reproduction of speech only, it can afford a greater mismatch than systems which reproduce music and speech. In the last analysis it is a compromise and each individual requirement determines the choice.

In view of the power-handling requirements of the output stage, only those substitutes, both triodes and pentodes, are usable which can handle power. These are interchangeable but only on that basis.

When two individual tubes are used in a push-pull output stage and a substitution is being contemplated for one tube, it should be carried out for both. If the characteristics of the original and the substitute differ markedly, parasitic suppressors may be required in grid and plate leads (if they are not already in the circuit). Fifty-ohm resistors capable of handling the currents involved are adequate. If two individual tubes replace two tubes in a single envelope, such resistors may prove very important because the changes in wiring and lengthening of the leads may cause oscillation.

Negative feedback is used in many audio systems between the output power stage and a preceding stage. Tube substitutions can upset the feedback conditions, especially if the electrical characteristics of the substitute are unlike the original. If audio quality or power over-all gain seems to have suffered too much, the feedback circuit should be checked.

When tube substitutions in a-f driver stages are contemplated, the range of substitutes is more limited than in the case of voltage amplifiers. While tubes designed for the driver stages of a-f amplifiers may be used in other capacities, tubes designed for other functions very often are not usable in a driver stage. Because the tube grid in the driver stage is driven into the positive region during certain portions of the signal cycle, the tube which feeds the driver-stage input transformer must be of the correct type for operation with the driver-stage input transformer. In like manner, the driver stage is impedance-matched to the transformer which feeds the succeeding stage. This is another requirement that must be satisfied when the substitute tube is selected from a number of types which possess

the required over-all similarity in electrical characteristics.

### Phase-Inverter Stages

Phase-inverter stages present no serious problems in substitution except for the fact that differences between the original and the substitute may demand readjustment of the load resistor so as to arrange that the signals from the phase-inverter stage to the control grids of the succeeding push-pull stage are of like magnitude. If the phase-inverter stage serves just one function, inverting the signal to one of the succeeding push-pull stage tubes, and it is of the same type as its related amplifier tube which feeds the other succeeding push-pull tube, then it may be convenient to *substitute like tubes for the phase inverter and its related amplifier.*

### Diode Rectifiers (Signal)

Too much need not be said about signal-rectifying diodes. One significant detail is that power rectifiers are not substitutes for signal rectifiers. (They are not shown as substitutes on the list, but the comment is still required.) There is very little to choose from between signal-rectifying diodes for virtually anyone will perform the functions of the others, except perhaps in connection with frequency of operation. The transit time (time taken for the electrons to advance from cathode to plate relative to the period of a cycle of the signal) limits the application of the tube in terms of frequency. Uhf diodes are suitable for operation at lower frequencies. On the other hand, the low or conventional frequency diodes are not suitable for the rectification of uhf and sometimes even vhf signals, unless so specified.

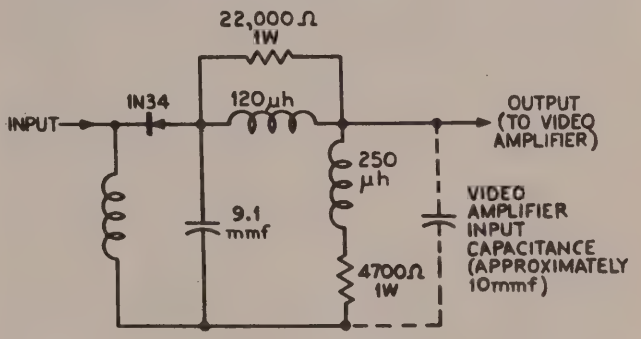
It is interesting to note that the equivalent of conventional signal-rectifying diodes may be formed out of conventional triodes by tying the grid and plate together thus forming one element, or by tying the plate to the cathode and using the control grid as the second element. Such equivalence is not indicated in the list of substitutions, but it should be kept in mind.

Sometimes multipurpose tubes used in receivers do not employ all of the electrodes. Quite frequently a duo-diode may have its two plates tied together forming a single diode to be used for a single purpose. It is well to try to disconnect one of the plates and to see if the operation is impaired; if not, then the other diode plate may, in conjunction with the common cathode, be used as the substitution diode. Whether or not such is possible depends upon the manner in which the common cathode is being used.

New advances in the design of germanium crystal diodes facilitate the use of these components as replacements for conventional diode tubes in signal-rectifying and detecting circuits. An important consideration in this connection is the fact that they require no heater supply and have an average life of over 10,000 hours.

Germanium crystal diodes are usable in vhf and even uhf circuits since their maximum operating frequency is about 500 Mc. They are rated for voltages of from 25 to 200 volts, with peak anode currents up to 200 ma. These components are particularly suitable for detector circuits where their low shunt capacities (of the order of 1 mmf) are advantageous.

The substitution of a crystal diode for a conventional-type tube is particularly simple because there is no need for a heater supply circuit. A typical use of a 1N34-type crystal diode is illustrated in Fig. 1-1.




*Courtesy Sylvania Electric Products Inc.*

Fig. 1-1. The use of a 1N34 type germanium crystal diode in the video detector circuit of a television receiver. Notice that the value of the circuit parameters are similar to those found in most video detector stages.

Here the component is shown being used in a video-detector circuit of the type common in most television receivers. The performance of the circuit with the 1N34-type crystal diode depends upon the proper choice of circuit parameters. In most circuits, however, it will be found that there need be no component modifications for good performance. Conventional-type tubes for which germanium crystal diodes are successful replacements are the 6AL5, 6H6, 6T8, and 12AL5. In the replacement of duo-diodes not only must the detector function be taken care of, but the sync limiter or other use must also be replaced. This is possible by using a 1N35-type matched duo-diode crystal component. See the table of geranium crystal diodes in Section 5.

For further information as to the use of germanium crystal diodes in video and f-m detector circuits as well as in other signal rectifiers, see *40 Uses for Germanium Diodes,* a booklet obtainable from Sylvania Electric Products, Inc.

### Diode Rectifiers (Power)

Power rectifiers are of two types, high-vacuum and gaseous. Normally, high-vacuum rectifiers are interchangeable as are gaseous ones, within the limitations set by the current and voltage ratings of the device.

Gaseous-type rectifiers frequently may replace vacuum-type rectifiers provided that the electrical characteristics are the same and the related circuit requirements are satisfied. Replacement of high-vacuum rectifiers by the gaseous kind is not recommended except when high currents are involved and when a constant voltage drop in the rectifier is required; the need for high voltage alone is not sufficient.

To take a typical case, the mercury-vapor rectifier requires choke input instead of capacitor input in the filter system. The high current surges which occur with capacitor input would destroy the gaseous tube. Also, gaseous tubes are suitable for the rectification of medium voltages and higher (500 volts output and up) and they are intended for systems wherein high current loads exist and where the variations in current load are large. In the case of a-c—d-c receivers, there are no gaseous equivalents for the high-vacuum types used. Gaseous rectifiers, moreover, are a source of r-f "hash" and, therefore, are not suitable for use in close proximity to circuits susceptible to such radiations.

High-vacuum tubes, on the other hand, are suitable replacements for mercury-vapor rectifiers if the rectifier system can stand the increased voltage drop which occurs in the high-vacuum tube and if the electrical requirements are satisfied. As a rule, the heater current for high-vacuum rectifiers is less than that required for gaseous rectifiers of comparable d-c voltage and current output. Other important electrical requirements to consider are the a-c input voltage, output current, and inverse peak voltage. The last-named term expresses the ability of the tube to withstand the peak voltage between the anode and the cathode during the nonconducting portion of the cycle.

Assuming the lack of recommended substitutes, high-vacuum tubes are suitable for substitution in systems which operate at lower d-c output voltages and currents than the high-vacuum tubes are rated for, provided that the heater requirements are satisfied. Such substitution should be made only in extreme cases when no other means are possible and a system must be restored to operation. For that matter, in such an event, the mercury-vapor kind also can be used provided that there is a choke input in the filter system. This is a MUST condition.

The substitution of a filament-type rectifier for a cathode-type one introduces certain complications, especially when the remainder of the tubes in the system are of the cathode-heater variety. The difference in heating time would result in the very rapid build-up of the voltage output from the rectifier before the tubes receiving the plate and other voltages were in a conducting state. Thus, the rectifier would be operating for a period of time with practically no load. This results in a high output voltage — much higher than when the load is applied — and could very easily break down the filter capacitors and also some of the bypass capacitors in the equipment receiving its voltage from the rectifier. Replacing a filament-type rectifier with a heater type causes no complications of this sort.

From a practical viewpoint it seems worthwhile to go to no end of trouble to find a suitable filament-type substitute for a filament-type original. This seems easier than changing the voltage rating of all of the filter capacitors and the bypass capacitors for high working voltage units. Of course, if examination of the capacitor voltage ratings and measurement of the rectifier output voltage shows that the momentary peak is within the operating voltage rating of the capacitors, the change can be made without endangering the filter and bypass units. If this is not the case and replacement of the filter and bypass capacitors is not feasible, then the only alternative is to use an increased bleeder load and thus reduce the over-all output voltage from the power supply.

For medium- and low-voltage requirements, selenium rectifiers are far more suitable substitutes for high-vacuum rectifier tubes than are gaseous tubes. Miniature selenium rectifiers are available in various sizes rated from 50 to 500 ma. The 50-, 65-, 75-, and 100-ma sizes will, in most cases, best serve as replacements for half-wave rectifiers in a-c—d-c equipment.

Generally speaking, to replace the vacuum-tube rectifier in a phonograph oscillator, use the selenium rectifier rated for 50 ma, for three-tube amplifiers use the 65-ma size, for five- or six-tube receivers without a push-pull output, use the 75-ma rectifier, and for six-tube sets and up use the 100-ma rated one. To replace the 25Z5, 25Z6, 35W4, 35Y4, 35Z3, 35Z4, 35Z5, 45Z5, 50Y6, and 50Z7, use a 403D2625A type selenium rectifier with a rating of 100 ma.

When a rectifier tube is replaced by a selenium rectifier, a compensating resistor must be inserted into the filament circuit to make up for the resistance drop due to the elimination of the rectifier tube if its filament was in series with other filaments. The value of this compensating resistor depends upon the rectifying tube that has been replaced. The following table lists the resistance to be used for the tubes mentioned above.

| TUBE | RESISTOR (ohms) | WATTS |
|---|---|---|
| 25Z5 | 85 | 15 |
| 25Z6 | 85 | 15 |
| 35W4 | 230 | 10 |
| 35Y4 | 230 | 10 |
| 35Z3 | 230 | 10 |
| 35Z4 | 230 | 10 |
| 35Z5 | 230 | 10 |
| 45Z5 | 300 | 10 |
| 50Y6 | 330 | 15 |
| 50Z7 | 330 | 15 |
| 117Z3 | none required | |
| 117Z6 | none required | |

In some sets, the pilot light may be connected across a low-voltage tap on the rectifier tube filament. If this

is so in the set in which the rectifier tube is being replaced, connect the pilot light across a tapped-down portion of the compensating resistor (about 10 to 25 ohms will do depending upon the current in the filament circuit). A No. 47 pilot light can be used in this case.

When replacing vacuum-tube rectifiers by selenium rectifiers in a-c—d-c portables using battery-type tubes that obtain filament voltages from B plus through a dropping resistor, reduce the value of the shunt resistor connected from the low end of the filament dropping resistor to the negative point. This will compensate for the increase in filament voltage.

In most cases, a protective resistor should be inserted in series with the selenium rectifier to protect the rectifier and filter capacitors from excessive current peaks during operation. The value of this resistor will vary from 5 to 50 ohms depending upon the current load of the rectifier; the higher the load, the smaller the protective resistor needed.

Manufactured adapters will probably be available for use with miniature selenium rectifiers in the future, in the meantime, they can be made fairly easily by using discarded tube bases. Following are instructions for making adapters for a few of the most popular rectifier tubes used in a-c—d-c equipment.

To make an adapter for the 35Z5 used in series circuits:

a) connect a 230-ohm, 10-w resistor from No. 2 to No. 7 on an octal base
b) connect a 20-ohm, ½-w resistor from No. 2 to No. 3
c) connect 25-ohm, ½-w resistor from No. 8 to positive side of rectifier
d) connect No. 5 to negative side of rectifier.

To make an adapter for a 35Z5 used by itself, follow the above steps but delete steps a) and b).

For the 25Z6, 25X6, 35Z6, 50AX6, 50Y6, and the 117Z6 when these tubes are used by themselves as half-wave rectifiers, make an adapter as follows:

a) connect a 25-ohm, ½-w resistor from Nos. 4 and 8 on octal base to the positive side of the rectifier
b) connect Nos. 3 and 5 to negative side of the rectifier.

If the filaments of these tubes are in a series circuit, then naturally a compensating resistor must be added with the selenium rectifier. This resistor, whose value may be obtained from the table given previously, will be connected between pins No. 2 and No. 7. No resistor is needed when the 117Z6 is replaced.

## Wideband Amplifiers (Video and Others)

Although referred to earlier in this section, these systems are singled out for elaboration because of their seemingly peculiar conditions of operation. Examination will show that very low values of plate-load resistance are used and also that the applied plate voltage is very low, much lower than that shown in tube characteristic charts.

This is so because it is necessary to have wide frequency response. Gain in each stage is sacrificed for the attainment of low reflected capacitance and also the creation of suitable resonance.[1] By means of shunt or series peaking, or both, a wide band of frequencies can be amplified. (This is explained in detail in the book referred to in the footnote.)

Tube substitutions in wideband amplifiers, therefore, require very serious consideration. The substitute tube characteristics should approximate most closely the complete conditions existing in the original. Interelectrode capacitance is very important. Plate-current, grid-bias, and grid-circuit resistance ratings should be the same. Lead dress must be maintained as much as possible because changes in the position of leads will affect the frequency of resonance and thereby the over-all bandwidth of the system. This is very important if socket changes are required.

If possible, all stages should be replaced by like substitutes even if only one stage requires replacement. This is expensive but advantageous. If the facility to check frequency bandwidth exists, then it is possible to confine the replacement to only one stage, the one in which the original tube is bad. Make the frequency run, and if the response is satisfactory after the replacement in that stage, the other stages need not be changed. Such tests can be made by means of a square-wave generator or a sine-wave generator. Usually the limits of response are expressed by the lowest and highest frequency signals which are down not more than 3 db from the top. In some instances, the amplifier design is more critical and the over-all response is expressed in terms of only 1 db down from the top.

## Utilization of Sections of Multifunction Tubes

A number of tubes found in television and other equipments combine three and four sets of electrodes in a single envelope, thus performing three or four different functions. Direct substitutions for these tubes may not be available. In that event it is necessary to utilize two individual tubes containing such electrodes as will furnish the facilities originally contained in the single tube which is being replaced. For example, a triple diode-triode such as the 6T8 may require replacement. If the original is not available, pairs of substitutes must be used, for example, a 6AL5 and a 12AV6 or a 6AL5 and 6AQ6. These are the recommended combinations, other combinations of a double-diode with a double-diode triode, or single diode-triode

[1] J. F. Rider and S. D. Uslan, *Encyclopedia on Cathode-Ray Oscilloscopes and Their Uses*, John F. Rider Publisher, Inc., New York, N. Y., 1950, pp. 389-401.

will function satisfactorily. One of these tubes takes over the function of two diodes in the 6T8 and the other tube takes over the function of the remaining diode-triode.

Substitution of two tubes for one is not easy; it means adding sockets and perhaps even changing sockets on crowded chassis where space is at a premium. This requires planning of the socket location and the location of shunt and series resistors, so as to keep connecting leads short. But it can be done, and it is a vivid example of how tubes with more electrodes (and capable of more functions) than the original may be used in replacements so long as only the necessary number of electrodes are utilized. Also it is an example of how it may be necessary to utilize several substitute tubes to perform the function of one original. Incidentally, pairs of tubes which can be used in place of other multifunction tubes are listed in an addendum to the tube substitution list. Which combination of substitute tubes fills the replacement of a single original is a matter of individual circuit design. Very many possible substitutions of this kind exist, especially in so far as signal diodes are concerned.

## Tube Substitution Techniques

Heater circuits are very significant in connection with tube substitutions because tube types are organized in terms of heater voltage. Therefore, it is quite in order to show the techniques involved in arranging tube heater circuits so as to accommodate substitute tubes. Before discussing the methods, however, in fact even before speaking about heater ratings, it might be well to emphasis one very important point, *all heater ratings are interpretable in terms of resistance.* The ohmic value of a heater is the same when it is operated on direct current or alternating current. Any reference to heater voltage considers the d-c value and rms or effective a-c value as the same. Thus a tube heater rating of 6.3 volts means 6.3 volts d.c. or 6.3 volts rms a.c. The same applies to any other numerical rating. Note: *Many battery-operated tubes will not function properly on a.c.*

Heater current is treated in like fashion. A reference to 0.15 ampere or 150 ma means d.c. or a.c., the latter being the rms value. The rms value is used because it is responsible for the heating effect in filaments and to get equivalent heating in d.c. and a.c., the d-c value must equal the rms a-c value.

While the above statement is true in all conditions associated with resistance, it should not be assumed to apply to all a-c systems regardless of circumstances. For example, the d-c value of voltage is related to the peak value of an a-c voltage when insulation resistance is involved. This is important in the operation of capacitors and in connection with the insulation breakdown of rectifier tubes during the nonconducting portion of the cycle.

## Heater Ratings versus Heater Circuits

It is common practice among electronic equipment manufacturers to use certain kinds of tubes for certain kinds of equipment. For example, in most a-c—d-c equipment, the tube heaters are connected in series across the line. The same is true when such equipment is intended for battery-operated portable use (the three-way portables). Other equipments are designed for operation from the a-c power lines only and the heaters are arranged in parallel chains. Still other equipments use a combination of series-parallel systems, as for example, a-c—d-c television receivers.

Sometimes the series chain is singular; sometimes there are a number of chains connected in series-parallel between different points as shown in the schematics at the end of Section 3. In the parallel systems, several independent parallel chains are used. Usually the rectifiers are wired individually and, in the true sense, are series circuits. The remainder of the tubes are, however, in parallel, all being on one chain or divided among a number of chains fed from individual voltage sources. These too are illustrated in Section 3. Incidentally, the receivers included in that section represent practically every one produced and sold in the years 1938 through October, 1950 as contained in Rider's TV Manuals Volumes 1 through 5.

## Parallel Circuits

Parallel chains will accommodate tubes which require equal heater voltage; they will also accommodate tubes with heater voltage ratings with are *lower* than that being supplied to the remainder of the tubes. This is shown in Fig. 1-2. The current rating of the heater is a matter of secondary concern in parallel chains.

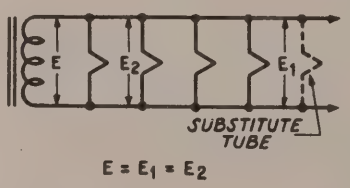



Fig. 1-2. Parallel connection of vacuum-tube heaters. The voltage drops across the heaters so connected are equal to the voltage across the secondary of the power transformer as shown.

If the supply voltage source (the heater transformer) is capable of supplying the required current at its rated output voltage, then any reasonable heater current requirement set by the substitute can be satisfied. The only limitation which exists relative to parallel connected heaters is that the output voltage rating of the heater transformer cannot be exceeded. The current through the parallel heater is determined by the resistance of the heater so that, if the voltage is correct, the current will be correct. If the current drain of the substitute heater added to the total current drain of the other tubes in the parallel chain exceeds the current output capabilities of the heater transformer, the

voltage will fall on all the heaters. It is possible to operate all receiving tubes at perhaps ten per cent below the normal voltage and current ratings. In special cases this reduction can be exceeded but it is not recommended.

Tube substitutes which bear heater voltage ratings lower than that of the original tube can be applied readily to parallel circuits. All that is needed is to *drop* the supply voltage to the level demanded by the substitute. The correction must be applied directly in the circuit which feeds the substitute tube. This is shown by the location of $R$ in Fig. 1-3. The amount of voltage to be dropped is the difference between the supply voltage $E$ and the tube heater requirement $E_1$. Suppose we wish to substitute a 2B7 with a 2.5-volt heater for a 6B7 whose 6.3-volt heater drew its supply from a filament transformer with an output of 6.3 volts. The difference $E - E_1$ is 3.8 volts and this must be dropped at the heater current rating of the substitute tube, namely, 0.8 ampere. The value of the voltage-dropping resistor then is

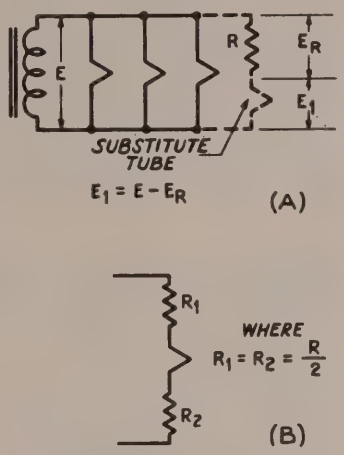



Fig. 1-3. When substituting a tube with lower voltage requirements than the original, a series resistor is added in the branch of the parallel feed in which the tube is placed. The resistor may be a single one as in (A), or two smaller ones as in (B).

$$R = \frac{E - E_1}{I} = \frac{3.8}{0.8}$$

or

$R = 4.75$ ohms or roughly 5 ohms.

The power rating of $R$ is

$$P = I^2R = 0.8^2 \times 4.75 = 3.204 \text{ watts.}$$

In the examples cited, the substitute imposes a load that is somewhat greater than the original; the power consumption of the 6B7 heater is 1.89 watts whereas that of the 2B7 is 2.0 watts. To this must be added the power dissipated across the voltage-dropping resistor $R$, for, after all, it is a part of the newly created load. Roughly, this amounts to 3 watts. So, the substitution of a 2B7 for a 6B7 means the imposition of a 5-watt load in place of the original 1.89 watts, or an increase in load of 150 per cent.

Normally, the addition of such a load will cause no trouble, but in the event that several tubes require substitution, the load may be increased to the extent that the voltage drop in the transformer secondary becomes excessive, and the voltage across all of the heaters will be lowered.

Some television receivers utilize a heater voltage supply which is the equivalent of two 6.3-volt windings in series, with the centertap grounded and acting as a common return path for two parallel chains of 6.3-volt heaters. This is shown in Fig. 1-4. Each winding furnishes 6.3 volts for its respective chain, but by virtue of a common center connection, the difference of potential between the extremes of the two windings is twice that of each, or 12.6 volts. Consequently, a 12.6-volt heater can be used by connecting it across the extremes of the windings.

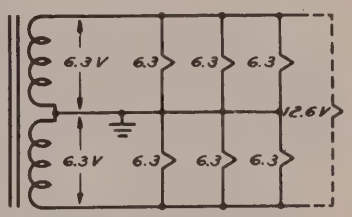



Fig. 1-4. Filament circuit of the type found in many television receivers. The center tap between the two windings is grounded to serve as a return for the filaments in parallel, each of which receives 6.3 volts from its part of the secondary.

If necessary, more than one tube substitution can be handled in this way. The voltage between the extremes of the two windings is a maximum which cannot be exceeded, therefore, even such an arrangement does not permit the use of a tube which requires more than 12.6 volts (or whatever the voltage happens to be between the two extremes of the windings).

The number of 12.6-volt tubes which can be handled in the manner shown in Fig. 1-4 is not without limit. The power-handling capability of the two windings is the controlling factor. The substitution of a single 12.6-volt tube in place of a 6.3-volt tube is no problem especially when the power consumption is the same for both heaters; more than likely it will not cause any concern even if an increased load is created by the selection of some special type of 12.6-volt tube.

## Series Circuits

The substitution of tubes in series-wired heater arrangements hinges upon the following fundamentals of Ohm's law relating to series circuits:

1. In a series circuit there is only one path for the current.
2. The current in a series circuit is equal to the applied voltage divided by the total resistance.
3. The sum of the individual voltage drops in a series circuit equals the applied voltage.

Illustrated in Fig. 1-5(A) are four tube heaters connected in series across a voltage supply source $E$. Only one path exists for the flow of current $I$, therefore, the current must be the same in all parts of the circuit,

that is, in each heater. This immediately establishes the requirement that all heaters connected in series must have similar current ratings. A variation of 10 per cent in heater rating is permissible so long as the heater has a higher rating than the current required by the other heaters in the circuit.

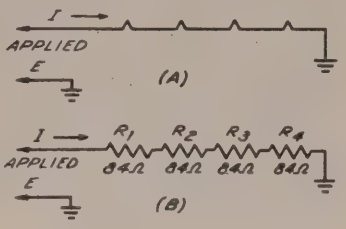



Fig. 1-5. Filaments connected in series (A) may be represented as individual resistances (B), each of which passes the same current determined by the applied voltage divided by the total resistance.

The numerical value of the current is dependent upon the applied voltage $E$ and the total resistance $R$ of all of the heaters, as stated in statement 2. above Since resistances connected in series are additive, the total heater resistance $R$, is equal to $R_1 + R_2 + R_3 + R_4$, as indicated in Fig. 1-5(B). If, for the moment, we assume that each heater is rated at 12.6 volts and 0.15 ampere (150 ma), then the resistance of each is 12.6 divided by 0.15 or 84 ohms. The four heaters in series, therefore, represent a total resistance of 336 ohms. Knowing the total $R$ and the required current, the supply voltage necessary to limit the current to the required value is

$$E = IR$$

or

$$E = 0.15 \times 336 = 50.4 \text{ volts.}$$

If the voltage drops across each heater (or the voltage required across each heater) are aggregated, it is seen that the sum of the voltage drops equals the applied voltage. Thus are illustrated statements 1., 2., and 3.

In view of what follows it might be well to devote a little more time to the matter of voltage drops and applied voltage, or the possibilities of statement 3. Current flowing through a resistance will cause a voltage drop across that resistance. If the current flow is the rated value, then the voltage drop numerically is the same as the voltage rating of the resistance. If the resistance is the heater (or filament) of a tube, and the current through it is the rated value, then the voltage drop is equal to the voltage rating of the heater.

We have simplified the problem by deliberately making the applied voltage (which we also can identify as the line voltage) equal to the total of the voltage drops in the load. As a rule, this is not found in practice; the line voltage always exceeds the total of the voltage drops across the tube heaters. This excess voltage is dropped by means of a line voltage-dropping resistor across which there is a voltage drop equal to the difference between the sum of the tube heater voltage drops and the line voltage. For example, if the line voltage is 117 volts and the total of the tube heater voltage drops is 50.4 volts as in the above case, the line voltage-dropping resistor will drop 117 — 50.4 or 66.6 volts at the value of current which is flowing through the series chain.

Statement 3 still holds, except that now the series line voltage-dropping resistor has been added to the elements (heaters) which comprise the load. This action of the line voltage-dropping resistor may be considered from a different viewpoint. It is the means whereby the line voltage is dropped to that value which equals the sum of the voltage drops across the heater elements. This is not a play on words; it simply presents the relationship between the line voltage and the total heater drops from two angles relative to the purpose of the line voltage-dropping resistor. In one case, the line voltage-dropping resistor is considered a part of the load and, in the other, only the tube heaters are considered to comprise the load. Personally, we prefer the former and shall hold to it in these explanations.

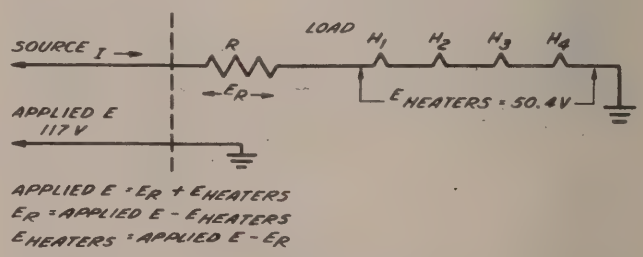



Fig. 1-6. A series chain of four filaments or heaters with a line voltage-dropping resistor. The voltage drop across the line voltage-dropping resistor makes up for the differences between the line voltage and the voltage required by the four heaters.

An example of the above is shown in Fig. 1-6. Here the elements of the load are shown to the right of the vertical dotted line and the applied voltage source is shown to the left. The series system indicates a total heater voltage drop of 50.4 volts at 0.15 ampere and a line voltage of 117 volts. The difference in voltage is dropped across the resistor $R$. Since the line voltage-dropping resistor is in series with the heater chain, the same current will flow through $R$ as through the heaters. The voltage drop across this resistor is, therefore, a function of the current through it and its resistance. Since this voltage drop represents a dissipation of energy, the line voltage-dropping resistor bears a wattage rating in addition to its resistance rating. The power dissipation is a very important factor and must be taken into account in the event of any changes; in fact, it determines the type of resistor element which suits this purpose. The power dissipation in watts is expressed by either $IE$, $I^2R$, or by $E^2/R$, where $I$ is the current in amperes, $R$ is the resistance in ohms, and $E$ is the voltage in volts, exactly the same units as are used for the other Ohm's law calculations.

The ohmic value of $R$ is

$$R = \frac{117 - 50.4}{0.15} = \frac{66.6}{0.15} = 444 \text{ ohms.}$$

Its power dissipation is

$$P = E \times I = 66.6 \times 0.15 = 9.99 \text{ watts (approx. 10 watts)}$$

or

$$P = I^2R = 0.0225 \times 444 = 9.99 \text{ watts (approx. 10 watts).}$$

To prove these figures, the total resistance of the four heaters is $4 \times 84$ or 336 ohms; adding this to the 444 ohms resistance of the line voltage-dropping resistor results in a total circuit resistance of 780 ohms. With a current of 0.15 ampere flowing in the system, the applied voltage is $E = 0.15 \times (336 + 444) = 117$ volts.

Let us now examine the possible variables in a simple series chain of the kind shown in Fig. 1-6. Statement 3. of Ohm's law relates to an equality between the line voltage (applied voltage) and the total of the voltage drops in the load. No restriction is evident concerning the *number* of elements (tube heaters) which may comprise the load and across which the total of the heater drops will occur. In the system shown in Fig. 1-6, four elements comprise the heater load. These could be any number provided that the total voltage drop did not exceed the line voltage; if it equaled the line voltage, then the line voltage-dropping resistor ($R$ in Fig. 1-6) would not be required in the circuit and the system would become the equivalent of Fig. 1-5(A), with more heaters than are shown there.

As a matter of fact, no matter what the total of the *rated* voltage drops across the heaters in the load is, this value can never exceed the applied (line) voltage, for statement 2. establishes that the current will adjust itself automatically in accordance with the total resistance and the total applied voltage. For example, if fourteen 12.6-volt, 0.15-ampere tubes were used in series across a 117-volt line, the total resistance would be 1,176 ohms. The current, therefore, would be

$$\frac{117}{1{,}176}$$

or 0.099 ampere, and the voltage drop across each heater would be $0.099 \times 84$ or 8.3 volts. It is obvious that the voltage across these heaters would be insufficient for proper operation of the tubes. Correction of this state would demand a revision of the circuit or an increase in the line voltage; the latter is impractical, so the former is the only solution. It will be treated later.

On the other hand, the need may arise to substitute a lower voltage rated heater for a higher rated one, such as a 6.3-volt tube for a 12.6-volt one. If the rated voltage drop across the series heaters is at least ten times the rated voltage drop across the substitute heater, the latter may be inserted into the string without requiring any correction. Thus, if the total rated voltage drop across the series heaters is 75 volts, and a 6.3-volt tube is a replacement for a 12.6-volt heater in the string, the replacement will be subject to a slightly higher voltage (and current) but it will do no harm.

For example, if the original series string consists of a 25-volt, 0.15-ampere tube and four 12.6-volt, 0.15-ampere tubes, the total resistance of these heaters is 502 ohms. Operation from a 117-volt line demands a dropping resistor of 227 ohms, making a total load resistance of 779 ohms. Substituting a 6.3-volt tube for the 12.6-volt one reduces the heater resistance to 460 ohms, and the total load to 737 ohms. This results in a circuit current of 0.158 ampere, and as a result, the 12.6-volt tubes are subjected to a voltage of 13.27 volts, the 6.3-volt tube to 6.6 volts, and the 25-volt tube to 26.4 volts. None of these voltages are so extreme as to endanger the tubes.

Battery tubes, however, should be treated with more care and every effort should be made to keep the voltage as close to the rated voltages as possible, especially when operation is intended on a-c lines.

Circuit conditions encountered in practice seldom are such that the total voltage drop across the heaters or filaments equals the applied or line voltage. The use of a line voltage-dropping resistor is very common, consequently, any change in the total voltage drop across the load caused by a substitution demands that the drop across the line voltage-dropping resistor be changed, and this means a change in its ohmic value. Whether the latter is done by shunting another resistor across it, by physically changing its length (as happens with line cords), or by substituting a new one of proper ohmic value for the original is determined by whichever is most convenient. If the total voltage drop across the heaters is *increased,* the drop across the line resistor must be *decreased,* and vice versa. A typical example follows.

Seven 6.3-volt heaters are in series with a 35-volt heater. All are rated at 0.3 ampere. The total voltage drop across the heaters is 79.1 volts and the total resistance of the heater load is 264 ohms as shown in Fig. 1-7(A). With a supply of 117 volts, 37.9 volts must be dropped across the line dropping resistor $R$. At 0.3-ampere current flow, the ohmic value of $R$ must be 126 ohms and its power dissipation, therefore, is 11.3 watts.

Two 12.6-volt, 0.3-ampere tubes must be substituted for two of the 6.3-volt tubes. The modified circuit is shown in Fig. 1-7(B). Simple calculation of the total voltage drop across the heaters shows an increase of 12.6 volts, therefore, it is obvious that the value of $R$ will have to be *decreased.* Its value may be determined

in a number of ways, but a simple procedure is the following

$$R_{new} = \frac{\text{Original value of } E_R - \text{Increased voltage drop across heaters}}{\text{Current through the system}}$$

$$= \frac{37.9 - 12.6}{0.3}$$

$$= 84 \text{ ohms.}$$

The power dissipation in the new $R$ is

$$P = I^2R$$

$$= 0.09 \times 84 = 7.5 \text{ watts.}$$

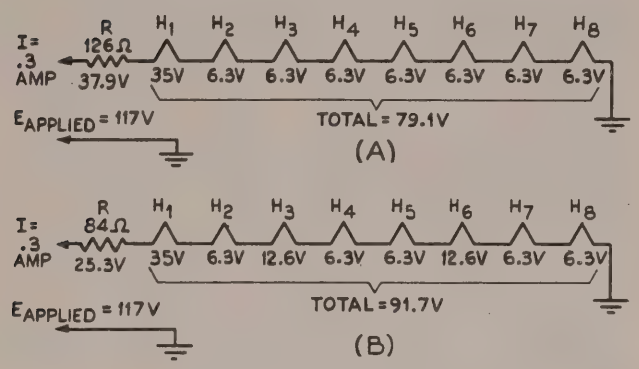



Fig. 1-7. In (A), a series chain of seven 6.3-volt heaters and one 35-volt heater requires a line voltage-dropping resistor $R$ of 126 ohms to bring the applied voltage of 117 volts down to the value required by the heaters. When the total voltage drop across the heater is increased by 12.6 volts as in (B), the value of $R$ must be decreased to 84 ohms.

## Substituting Low-Current Rated Heaters for Higher-Current Heaters

Suppose that in the circuit of Fig. 1-7(A) two 12.6-volt heaters rated at 0.15 ampere must replace two of the 6.3-volt 0.3-ampere heaters. Let us select $H_3$ and $H_6$ as the specific heaters. How would this be accomplished? Two methods are practical, one being simpler than the other. Suppose we treat the more difficult one first.

Since the circuit current is 0.3 ampere and each substitute heater draws only 0.15 ampere, it stands to reason that they just cannot be connected into the circuit as is, otherwise each would be subject to a 100 per cent current overload. However, two such heaters connected in parallel would require 0.3 ampere, and because of the division of currents in a parallel circuit in accordance with the resistance of each branch, connecting these two tubes in parallel would result in 0.15 ampere flowing through each heater. Moreover, the voltage drop across two elements in parallel is the same as that across a single element and, since the total drop across the two 6.3-volt heaters which are being replaced equals 12.6 volts, the two 12.6-volt heaters in parallel can replace the two individual 6.3-volt heaters without changing the total voltage drop across the string of heaters. This is shown in Fig. 1-8(A). Note that the total drop across the string of 6.3-volt heaters originally [Fig. 1-7(A)] was 79.1 volts, and that the total drop across the heaters with the two parallel 12.6-volt substitutes is 79.1 volts. This means that the line dropping resistor $R$ need not be changed since it is called upon to drop 37.9 volts at 0.3 ampere, the same as in the original circuit.

The other means of accomplishing the substitution is shown in Fig. 1-8(B). Instead of connecting the two

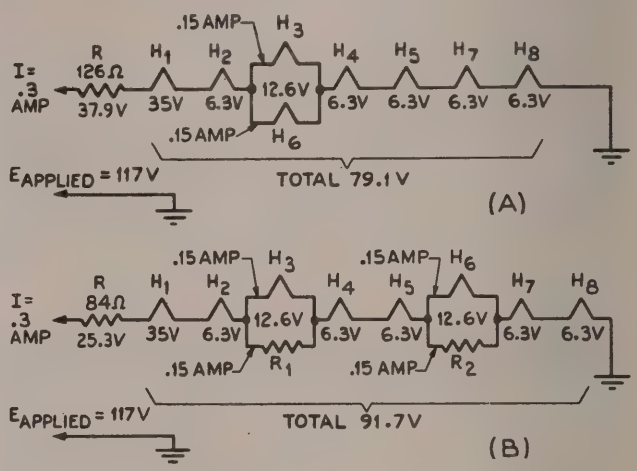



Fig. 1-8. Two methods of substituting 12.6 volt, 0.15-ampere heaters for 6.3-volt, 0.3-ampere ones are shown. In (A), both substitutes are paralleled together, splitting the current and keeping the voltage drop of the system intact; in (B), each heater has its own shunt, thereby drawing its rated current but increasing the total voltage drop of the heaters.

substitute heaters in parallel, they are treated individually and separate current shunts are connected across each one. Since it is desired to split the current equally between the heater and its shunt, the ohmic values of the shunts must equal the resistances which they shunt. This means that $R_2 = 84$ ohms and $R_3 = 84$ ohms, and each dissipates 1.89 watts. [See Fig. 1-8(B)].

However, handling these substitutions in this manner means that the total voltage drop across the string of heaters has been increased by 12.6 volts, since two 12.6-volt heaters in series total 25.2 volts, and two 6.3-volt heaters in series total only 12.6 volts. The increased drop of 12.6 volts must be compensated for by reducing the drop across the line resistor $R$. Figs. 1-7(A) and 1-8(A) are comparable, as are Figs. 1-7(B) and 1-8(B). In Figs. 1-8(A) and (B), the total line current of 0.3 ampere flows into the junctions of the parallel systems (the parallel heaters in (A), and the heaters paralleled by the shunt resistors in (B), divides equally between the two paths, and then recombines again to equal the 0.3-ampere line current. Thus, the 0.3-ampere, 6.3-volt heaters receive the proper current and so do the two 12.6-volt, 0.15-ampere heaters.

If four tubes required substitution and they were of like voltage ratings, two pairs of heaters could be paralleled as shown in Fig. 1-8(A). If there were an odd number of substitutions, two heaters could be located in parallel and the odd one would be operated with a shunt as shown in Fig. 1-8(B). As a matter of fact, it is the principle underlying these techniques rather than the actual number of tubes involved which is important. Once the principles are understood, it will be simple to apply them, and in general, the most convenient method should be used depending on the circuit and the components available. For example, the availability of resistors is a determining factor in deciding whether the line dropping resistor will be replaced or if two small resistors will be used for the current shunts. If the substitution demands new sockets, then paralleling of the heaters is no problem, but if the sockets do not require changing to accommodate the substitutes it is more convenient to use the current shunts.

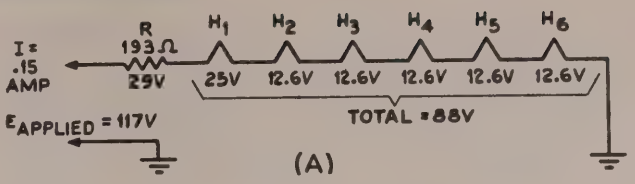



Fig. 1-9(A). A series chain of heaters each drawing 0.15 ampere in a circuit with a single voltage-dropping resistor.

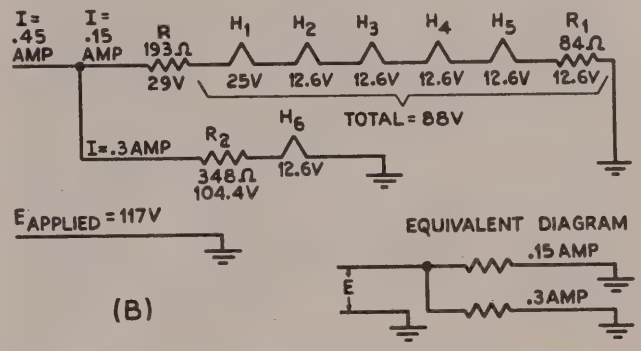



Fig. 1-9(B). $H_6$ of Fig. 1-9(A) has been replaced by a 12.6-volt, 0.3-ampere one requiring a separate series circuit and an increase in the current drawn from the line source. Now there are two dropping resistors, one in each branch of the circuit.

## Substituting Higher-Current Heaters for Low-Current Heaters

Suppose the requirement is for the use of higher current heaters in place of lower current heaters in a series circuit. A single 0.3-ampere heater is to replace one rated at 0.15 ampere in a series string of five 12.6-volt, 0.15-ampere heaters and one 25-volt, 0.15-ampere heater. This substitution is to occur at $H_6$ in Fig. 1-9(A). Several solutions are shown in Figs. 1-9(B) through (G). The choice is determined by which is most convenient and best fits the need. The one fundamental requirement created by such a substitution is that the total line current must be increased to 0.3 ampere so as to serve the increased current demand of the substitute tube. Whether this means that the line current will be limited to 0.3 ampere or increased above that value is determined by the organization of the heaters which form the load. One circuit system [Fig. 1-9(B) and (C)] needs 0.45-ampere line current, whereas other arrangements can be served by 0.3 ampere; there is no way, however, of satisfying the requirements of the 0.3-ampere tube with a line current of 0.15 ampere. For comparison, let us keep the constants of the original circuit [Fig. 1-9(A)] in mind. Here we have a total drop of 88 volts across the heaters, and 29 volts across the line dropping resistor at a current flow of 0.15 ampere.

One solution for the substitution is the use of two series paths, one for the 0.15-ampere heaters and the other serving the 0.3-ampere heater, as shown in Fig. 1-9(B). In order not to change the total voltage drop in the 0.15-ampere chain, a resistance (84 ohms) corresponding to that of the heater ($H_6$) which has been removed is inserted in its stead. This establishes the total voltage drop at the original value of 88 volts and

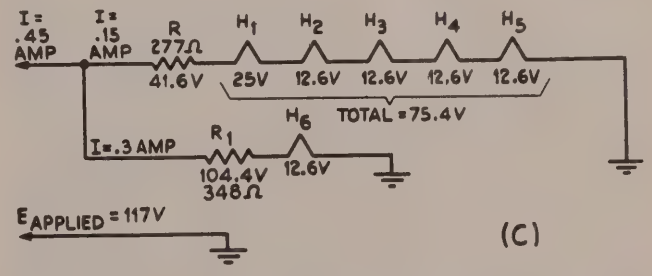



Fig. 1-9(C). Same as Fig. 1-9(B) except that the dropping resistor in the longer branch now is a combination of the dropping resistor $R$ and the compensating resistor $R_1$ of the previous diagram.

the original line dropping resistor remains intact. Compare Figs. 1-9(A) and (B). Since the drop across the 0.3-ampere heater is 12.6 volts and the line voltage is 117 volts, a line dropping resistor must be added to this circuit. $R_2$ serves this purpose; its ohmic value (348 ohms) is such that it will drop 104.4 volts at 0.3 ampere.

Examination of the two series circuits of Fig. 1-9(B) shows that they are actually in parallel since each goes from the 117-volt line to ground. This is illustrated in the equivalent diagram in Fig. 1-9(B). The total resistance of each of the parallel branches is such that 0.15 ampere flows in one, whereas 0.3 ampere flows in the other.

The equivalent circuit in Fig. 1-9(B) is an important one to understand because it shows the application of two series circuits connected in parallel. Television receivers intended for use on a-c—d-c lines employ such circuit arrangements quite frequently, see Fig. 1-8 and the schematics at the end of Section 3.

A modification of Fig. 1-9(B) appears in (C). The substitution requirement remains the same, but this time the resistance equivalent of the heater which has been removed is not inserted. Instead, the line dropping resistor is changed in value so as to compensate for the reduced total voltage drop across the heaters. With one 12.6-volt heater removed, it has fallen to 75.4 volts from the original 88 volts. This necessitates an increase in the line resistor $R$ from the original value of 193 ohms to 277 ohms. (This follows from the fact that the heater removed from the string had a resistance of 84 ohms, and in order to maintain the original amount of current in the circuit, this amount of resistance must be added to the line dropping resistor. The change is essentially the transposition of the resistor $R_1$ in Fig. 1-9(B) from its position at the grounded end of the string to the line dropping resistor.) Now the drop across the line dropping resistor is 41.6 volts, or the original 29.6 volts plus the 12.6 volts representing the displaced heater. The second series leg of the circuit is the same as shown in Fig. 1-9(B), because its demands have not been changed in any way by the modifications applied to the other series circuit.

Several other interesting details may be mentioned about the arrangements in Figs. 1-9(B) and (C). In the latter, the increase in the value of the line dropping resistor means an increase in power dissipation. The power dissipation in the resistor in (B) is 4.34 watts; the power dissipation in the resistor in (C) is 6.23 watts. However, it is necessary to add to the former the amount dissipated in the resistor $R_1$ which has replaced the heater. This power is 1.89 watts, which when added to the 4.34 watts, totals the same amount as is dissipated in the higher value of resistance used in Fig. 1-9(C). At first glance there may appear to be no difference between the two systems, yet there is a substantial difference. It is simply that two resistors, one of 4.34 watts and another of 1.89 watts rating (or whatever may be the wattage ratings selected to afford ample safety factor), are definitely more expensive than a single resistor of such wattage rating as will satisfy a power dissipation of 6.23 watts.

For purposes of comparison let us identify the power dissipation in the system shown in Fig. 1-9(C). The power dissipation in the 150-ma leg is 11.34 watts in the heaters and 6.18 watts in the line dropping resistor $R$, a total of 17.49 watts. The power dissipated in the 300-ma circuit is 3.78 watts in the heater and 31.32 watts in the line dropping resistor $R_1$, making a branch total of 35.10 watts. The dissipation in both circuits is the sum of the branch wattages or 52.59 watts.

A third possible arrangement for the substitution is shown in Fig. 1-9(D). In a way, this is a more practical way to connect a 12.6-volt, 0.3-ampere heater in place of a 0.15-ampere heater of like voltage rating. Only one series string is arranged, although it contains two parallel circuits. This system operates in a similar manner to that shown in Fig. 1-8. Of course, the ability to assemble such a circuit depends upon the number of heater elements present. The four heaters $H_2$, $H_3$, $H_4$, and $H_5$ are of like constants, therefore, two series pairs connected in parallel result in a system requiring 25.2 volts and 0.3 ampere. In order that heater $H_1$ draw only 150 ma, it is shunted with a resistance equal to its own resistance. Thus, the original six tubes now are arranged so that they can be assembled into a single series string and supplied with 0.3 ampere of current.

The rearrangement of the 150-ma tubes reduces the total voltage drop across the heaters because the paralleled pair of series heaters draws only 25.2 volts compared to its former 50.4 volts. The result is that the total drop across the heaters is reduced to 62.8 volts. This requires a change in the line dropping resistor to that ohmic value (181 ohms) which will draw 54.2 volts and so drop 117 volts to the 62.8 volts at 0.3 ampere required by the heaters. Relative to the power consumption in such a system, the four series-parallel

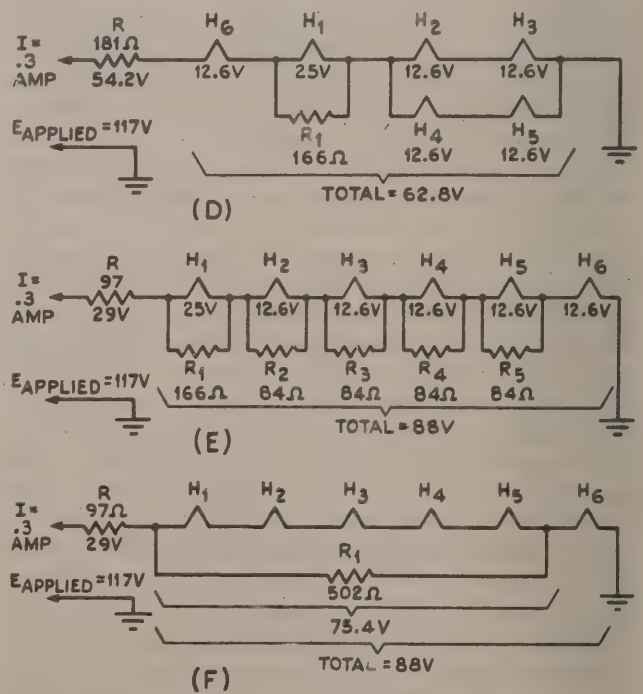



Fig. 1-9(D), (E), and (F). Various methods are shown here for shunting the heaters of the circuit shown in Fig. 1-9(A), after the substitution of a 12.6-volt 0.3-ampere heater for $H_6$, so that the voltage and current requirements of each heater are satisfied.

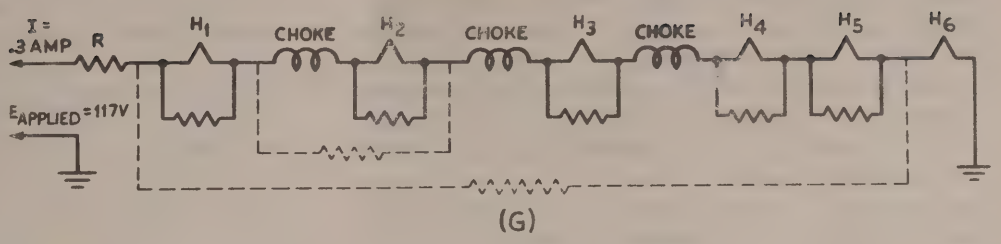



Fig. 1-9 (G). Part of a television receiver filament circuit showing the isolating chokes used between the heaters in the series chain. The shunts shown in dotted lines are unacceptable because they nullify the action of the chokes.

heaters dissipate 1.89 watts each for a total of 7.56 watts; the 25-volt heater $H_1$ with its shunt consumes 7.5 watts; the 12.6-volt 300-ma heater $H_6$ consumes 3.78 watts; and the line dropping resistor consumes 16.26 watts. The total power dissipation of the whole circuit is, therefore, 35.1 watts. A comparison between the total power consumption of the circuit in Fig. 1-9(D) and that in Fig. 1-9(C) illustrates the economy in power consumption possible by a choice of circuits.

A modification of the circuit in Fig. 1-9(D), designed to allow the replacement of a 150-ma heater tube with a 300-ma one, is shown in Fig. 1-9(E). Here, all the heaters are in a single chain with a current shunt across each 150-ma tube; the 300-ma heater $H_6$ does not require a shunt. The ohmic value of these shunts is equal to the resistance of each of the shunted heaters. The power consumption of the entire system totals 36 watts made up as follows: each of the shunted 12.6-volt heaters with its shunt consumes 3.8 watts, the unshunted 0.3-ampere tube requires approximately the same amount of power, the 25-volt shunted heater with its shunt consumes 7.5 watts, and the line dropping resistor consumes 8.7 watts, a total of 35.2 watts. This is slightly more than the consumption of the circuit of Fig. 1-9(D), but it is much less than that required by circuit 1-9(C). As to the relative ease of installation of circuits 1-9(D) or (E), it is a matter of specific circumstances, there being little to choose in terms of power saving.

The reduction of the line voltage-dropping resistor $R$, in Fig. 1-9(E) is significant. It means a smaller unit and one with lower power dissipation rating, making it more convenient to install than larger units.

A simplification of the shunted heaters is shown in Fig. 1-9(F). Instead of individual current shunts, a single shunt $R_1$ of suitable value (equal to the combined resistance of the shunted heaters) is connected across the 150-ma heaters, $H_1$ to $H_5$. As indicated in the diagram, this resistance amounts to 502 ohms, which is the aggregate of four heaters of 84 ohms each, and one heater of 166 ohms. The 300-ma heater $H_6$ requires no shunt, therefore, it is not included by the common shunt $R_1$.

The use of a common shunt across several tube heaters is not generally applicable to television receivers without taking special precautions. The reason for this is that it is common practice in series-wired television receivers to isolate one heater from the other by means of isolating chokes [see Fig. 1-9(G)]. These are part of the filament circuit, but their d-c resistance is extremely low. Any attempt to shunt current around these heaters must exclude the choke from the shunted circuit otherwise the effectiveness of the choke will be materially reduced, if not completely nullified. This means that the current shunts shown in dotted lines in Fig. 1-9(G) are undesirable, instead, each tube should be shunted separately and care must be exercised to see that the shunt is connected directly across the terminals of the related heater and does not include the associated choke.

### Series-Parallel Circuits

Having described the parallel and the series systems separately, the organization of the series-parallel system should pose no problem. It is doubtful that the occasion will arise which requires the design of a complete new heater system, usually, the substitution involves one or two tubes at the most and these can be treated as illustrated in Figs. 1-9(B) through (G). An example of a series-parallel combination somewhat more complex than the usual is illustrated in Fig. 1-10. To simplify the treatment of this circuit, we will divide the heaters into two strings, and examine each separately.

In string 1, heaters $H_1$ and $H_8$ require heater current equal to the total line current entering the string. Heaters $H_2$ through $H_7$ are alike in their requirements for they draw the same current and voltage, however, the total current drawn by these heaters is less than $I_1$ because of the presence of the current shunt $R_1$. Furthermore, we note a number of voltage drops in string 1 indicated by the letter $E$ with subscripts. Voltage drop $E_1$ appears across the extreme limits of the string and is equal to $E$, the line voltage. The presence of the line dropping-resistor $R$ in series with the heaters in string 1 indicates that the total voltage drop in the system $E_{11}$ is less than the applied voltage. The latter is equal to the sum of $E_{11}$ and $E_{12}$. In turn $E_{11}$ is composed of the sum of the voltage drops $E_a$, $E_b$ and $E_c$.

Suppose, for the moment, that heater $H_1$ is rated at 25 volts and 0.8 ampere, heater $H_8$ is rated at 12.6 volts and 0.8 ampere, and heaters $H_2$ through $H_7$ are rated at 12.6 volts and 0.15 ampere. This identifies $E_b$

as being 37.8 volts, and $E_{11}$, therefore, amounts to 25 + 12.6 + 37.8 or 75.4 volts. The line dropping resistor $R$, therefore, disposes of 41.6 volts at 0.8 ampere. The series-parallel arrangement of heaters $H_2$ through $H_7$, without the shunt $R_1$ requires only 0.3 ampere, however, the line current is 0.8 ampere. Therefore, shunt $R_1$ must bypass 0.5 ampere. Its value can be determined by $R = E/I$, where $E$ is the voltage across the shunt, in this case $E_b$ (37.8 volts), and $I$ is the current to be shunted through the resistor (0.5 ampere). $R_1$, therefore, is equal to 75.6 ohms.

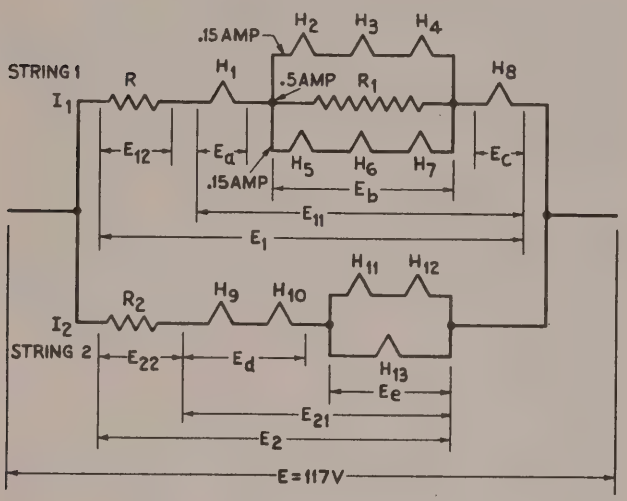



Fig. 1-10. In a series-parallel arrangement of tube heaters such as shown here, each string should be considered separately to find the requirements of each heater.

The distribution of voltages and currents in string 2 requires no special comment. What has been said so far will make the organization of this string easy to follow with the possible exception of the shunting of heater $H_{13}$ across the series pair $H_{11}$ and $H_{12}$. This is made possible by virtue of the relative voltage ratings of these three heaters; heaters $H_{11}$ and $H_{12}$ are rated at one-half of that of $H_{13}$, or the total drop across the series pair $H_{11}$ and $H_{12}$ equals the drop across $H_{13}$. The total current drawn by $H_{11}$, $H_{12}$, and $H_{13}$ must equal the current flowing in the line through $H_9$ and $H_{10}$. Further examples of such circuits will be found in Section 3.

## Dual-Heater Voltage and Current Tubes

Some tubes contain dual heaters which are connected in series and tapped at the midpoint, offering three points for connection. They bear one voltage rating when the two heaters are used in series and another voltage rating (half the previous value) when they are connected in parallel. Naturally, the parallel connection bears a current rating which is twice that of the series rating. Circuitwise, the heaters appear as shown in Fig. 1-11, and are listed in a tube characteristic chart as follows:

| TUBE TYPE | FILAMENT VOLTAGE | OR | HEATER CURRENT |
|---|---|---|---|
| 3E6 | 1.4 | | 0.10 ampere |
| | 2.8 | | 0.05 |
| 12AT7 | 6.3 | | 0.3 |
| | 12.6 | | 0.15 |

Fig. 1-11. Dual heaters such as appear in dual-heater tubes have their midpoint tapped. This makes it possible to connect the heaters either in series or in parallel with each other.

The use of such tubes in a system affords a more convenient means of substitution than the use of single rated heaters for, by simply arranging the heaters in parallel, they can be made to serve in circuits which require the lower of the two voltages and the higher of the two current ratings. By using the tube with series-connected heaters, it will suit the needs of circuits which require the higher voltage rating and the lower current rating.

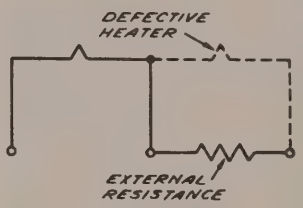



Fig. 1-12. A defective heater in a dual-heater tube may be replaced by an external resistor equal in resistance to the defective element.

Each of these dual heaters is a resistance and, when the heaters are used in parallel, the resultant resistance is half that of either. When they are used in series, the total resistance is equal to twice that of either. In the event of failure of either heater, the remaining heater is capable of causing sufficient electron emission from the cathode and the tube may be treated as if it had but one heater. If it is a matter of maintaining a certain voltage drop in a heater system, the defective heater may be replaced by an external resistance equal in value to that of the original heater. This is illustrated in Fig. 1-12. It must, of course, be understood that when this external resistance replaces the bad heater it will contribute nothing to the emission.

## Resistor Substitution

A number of factors control the substitution of resistors, these are:

a. Type (wire or processed)
b. Ohmic value
c. Tolerance
d. Wattage rating.

Relative to the type, wire-wound resistors should not be used in frequency-sensitive circuits unless so stated. The reason for this is the winding has inductance and distributed capacitance. If a resonant peaking circuit contains a carbon resistor in series with the peaking coil, replacing that resistor with a wire-wound unit will change the frequency of resonance, and so alter the operation of the device. Such conditions will be found in wideband amplifiers. In general, therefore, replacement resistors should be of the *same type* as those which were removed. Carbon resistors are preferable in all high-frequency circuits, unless otherwise indicated. In circuits which are not frequency sensitive, the replacement of a processed resistor by a wire-wound one is satisfactory, except when wire resistors appear in both grid and plate circuits of the same tube. This may result in feedback and oscillation in amplifier circuits which handle reasonable amounts of power. Resonance may be created by means of the related distributed capacitance and the inductance of the resistor.

Concerning the ohmic value, it is assumed that the correct substitution will be made with whatever tolerance is indicated in the reference information that describes the constants of the circuit where the replacement is being made. Data concerning tolerance identifications on processed resistors will be found in Section 5.

Sometimes, a single resistor must be replaced by two resistors or a shunt must be added so as to change the ohmic value of a portion of the circuit in order to satisfy the requirements of a tube substitution. The equivalence between a single resistor and other combinations which can produce the same value is shown in Fig. 1-13.

When resistances are in series, the total resistance is equal to the sum of the individual resistances, no matter how many there are [Fig. 1-13(A)]. The resultant resistance of two resistances in parallel is equal to the product divided by the sum, see Fig. 1-13. The number of resistances which may be placed in parallel is limited by practical considerations. If more than two must be shunted in order to arrive at a certain resultant, the following equation should be used

$$\frac{1}{R} = \frac{1}{R_5} + \frac{1}{R_6} + \frac{1}{R_7} + \ldots \text{ [see Fig. 1-13(C)].}$$

For the case of three parallel resistors, the resultant reduces to the fraction shown in Fig. 1-13(C).

Sometimes the situation demands that a certain resistance be shunted by another to produce a certain final value. The ohmic value of the shunt is determined as follows

$$R_{\text{shunt}} = \frac{\text{desired resistance} \times \text{original resistance}}{\text{original resistance} - \text{desired resistance.}}$$

For example, a 100,000-ohm load resistance must be reduced to 30,000 ohms in order to suit the new tube used. What shall be the ohmic value of the shunt required for this job? Using the equation given above

$$R_{\text{shunt}} = \frac{30{,}000 \times 100{,}000}{100{,}000 - 30{,}000} = \frac{3{,}000{,}000{,}000}{70{,}000}$$

$$= 43{,}000 \text{ ohms (approx.).}$$

Tolerance ratings, expressed in percentage, are the amounts by which a rated resistance may differ from the actual resistance of the element. A plus tolerance means that the actual value may be higher than the rated value by some amount not exceeding the tolerance figure; a minus tolerance means that the actual value may be lower than the rated value by some amount not exceeding the tolerance. Thus, a 1-megohm resistor rated at + 5 per cent means that it may be as high as 1,050,000 ohms; if the tolerance was — 5 per cent, its value might be as low as 950,000 ohms. Combining a plus tolerance resistor with a minus one is a good way of arriving at a desired resultant when two of like value are not available. There are many resistors that have a plus and minus tolerance rating. Thus, a 1,000-ohm resistor of ± 10 per cent may be as high as 1,100 ohms, or as low as 900 ohms.

The power dissipation in a resistor carrying current may be expressed by any one of the following methods

$$P = I^2R = \frac{E^2}{R} = EI$$

where $I$ is the current flowing through the resistor; $R$ is its ohmic value, and $E$ is the voltage drop *across* the resistor. In most cases, the wattage rating of a resistor is an important factor. In certain grid circuits, however, where the current is so small as to be negligible, the resistor's power dissipation value is not important. A half-watt rating will be found suitable for all such circuits. However, in those instances when

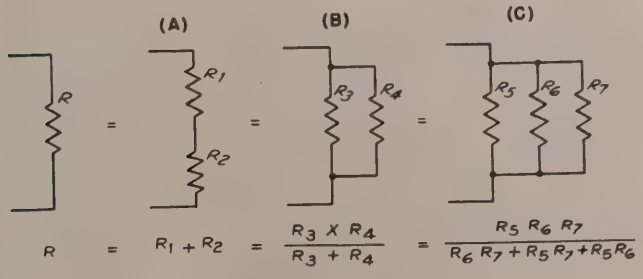



Fig. 1-13. The use of a combination of resistors to produce the same total resistance as a single one is shown in (A), (B), and (C). The total resistance of each of the combinations may be found from the formula beneath it and is equal to the single resistance $R$ shown at the left.

grid current exists and is used to develop all or part of the grid bias, the wattage rating must be based upon the calculated power dissipation. In general, a maximum safety factor of 100 per cent should be allowed above the calculated value. This means that the wattage rating of the resistor chosen should be equal to twice the calculated power dissipation. Such a factor of safety is more than ample. For example, if the dissipation is 1.2 watts, use a 2-watt resistor; if it is 3 watts, use a 5-watt resistor; if it is 6 watts, use a 10-watt resistor; and if it is 13 watts, use a 20-watt resistor. Note that the required wattage is slightly less than double the calculated value in each case. Thus we see why a 100-per cent factor of safety is considered a maximum.

A consideration of moment is the possible tube damage resulting when a resistor burns out. If damage can result due to an excessive rise in plate current or voltage, in the event that a resistor burns out, it is advisable to use a resistor which has a higher wattage rating than the one being replaced.

If the occasion arises to replace a resistor in one leg of a balanced circuit, for example, in the plate or grid circuit of a push-pull stage, it may be necessary to replace the resistor in the other leg also so as not to disturb the balanced condition of the circuit elements. When a replacement is made in such a case, both resistors should have not only similar ohmic values, but should be of similar construction and have similar tolerances and wattage ratings as well.

### Fixed Capacitor Substitution

The cardinal factors associated with fixed capacitors are the capacitance, d-c working voltage, and leakage resistance. The requirements relative to capacitor values are so obvious as to require no discussion other than to mention the equivalence between several arrangements, as shown in Fig. 1-14. Two like-value capacitors in series produce a resultant which is equal to one-half the capacitance of either one. Two or more unlike capacitors in series are treated the same as resistors in parallel. Capacitors in parallel are additive.

The d-c working voltage corresponds to the peak a-c voltage which may be applied to the capacitor. Practically speaking, d-c working voltage ratings are somewhat lower than can actually be applied to the capacitor

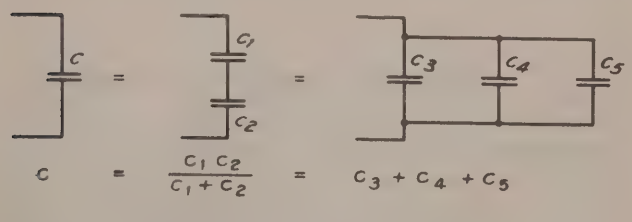



Fig. 14. Combinations of capacitors which give resultant capacitances equal to that of a single capacitor are shown here with the resultant capacitance of each combination listed below it.

because of the safety factor, but common sense dictates that operations should be carried on within the limits set by the rated working voltage. In view of this situation, care must be exercised against interpreting the d-c working voltage as being the equivalent of the rms or effective value of a-c voltage; if this is done, the probability exists that the peak a-c voltage in the circuit will puncture the capacitor. The correspondence between these different values of voltage is as follows

D-C Working Voltage = Peak A-C Voltage = 1.414 × RMS Voltage.

If by error the rms voltage in a circuit equals the d-c working voltage rating of the capacitors, the peak a-c voltage in those circuits (exclusive of surges) will be 1.414 times higher. If any question arises concerning the rms voltage and the d-c working voltage of a capacitor in a circuit, the rms voltage which is usable may be found from the following equation

RMS Voltage = D-C Working Voltage × 0.707.

This is an important consideration in rectifier systems and wherever both a-c and d-c voltages are involved. The input capacitors in capacitance input filter systems should have a d-c working voltage rating which is somewhat higher than the peak voltage available from the plate winding of the power transformer. This will take into account possible surges which may occur. It is well to bear in mind that repeated failure of capacitors at one point in a system is proof of an insufficient voltage safety factor in the selection of the voltage rating. This is especially true when a substituted rectifier is of the filament type, whereas tubes which receive their voltage from the rectifier are of the heater type. In such cases, high voltages will prevail in the rectifier during the time required for the load tubes to reach the conducting state.

If parallel or series capacitor combinations are used as replacement for a single capacitor, care must be taken that the d-c working voltage across each part of the combination is its rated one. For example, if two capacitors are in series the voltage across each should be inversely proportional to their capacitances and together should equal the total voltage across them. When the combination is a parallel one, the same d-c working voltage will appear across each capacitor.

The d-c leakage in fixed capacitors is an important item in connection with substitution. For example, capacitors which are intended to isolate one point from another relative to d.c. should have low leakage, which means high insulation resistance. High leakage in coupling capacitors can very materially influence the bias on the grid of the tube connected to the resistor and adversely affect the performance of that tube. In this connection, electrolytic capacitors have the highest leakage, paper dielectric capacitors are lower, and mica or ceramic capacitors have the lowest leakage. Vacuum capacitors are, of course, ideal but their use is limited mostly to high-voltage points in transmitters and similar equipment.

When working in high-frequency circuits, the substitution should, if at all possible, be a duplicate of the capacitor being replaced, which in many cases will be a ceramic capacitor. If it is not available, then a mica is the next best choice.

As a means of conserving space, some ceramic capacitors are dual units, that is, the same housing includes a resistor (possibly more than one) which is associated with the operation of the device. Sometimes two such capacitors and a resistor, forming a complete load assembly, may be in one unit. These should be replaced as a unit, but in an emergency, a substitute may be used for only that part of the assembly which has failed. Note: an examination of a circuit may disclose more components than are present physically; some of these "missing" elements may be included in dual units.

## I-F Transformer Substitution

The replacement of i-f transformers is determined by circuit location and circuit constants. The location determines whether it falls within the category of an "input," "interstage," or an "output" transformer. These identifications are found in service notes and parts catalogs. With the exception of receivers which contain only a single stage of i-f amplification, all superheterodynes make use of the aforementioned three general types of transformers. The input and interstage kinds may be interchangable but the output transformer, which feeds a diode demodulator, is of a special design. Therefore, when it is necessary to replace the i-f transformer which feeds the signal to the diode demodulator, every effort should be made to secure a replacement which has been designed to perform that function.

Substantial differences may be found in the numerous varieties of i-f transformers which are employed by receiver manufacturers. Replacement of identical units is possible only by procuring the part from facilities related to the original receiver manufacturer. However, general replacement i-f transformers are suitable substitutes if the proper precautions are exercised when the substitution is made. For example, some i-f transformers used in combination a-m—f-m receivers are of the dual-frequency variety, that is, two different transformers contained in the same can. In other cases, trimmers, or filter elements related to the stage are contained in the same can with the transformers. Examples of these two are shown in Figs. 1-15(A) and (B).

The replacement of such devices by substitutes involves consideration of all of the factors involved. Two individual i-f transformers, an a-m and a separate f-m unit, may be connected externally to form the equivalent of the original shown in Fig. 1-15(A). However, if the original contains additional elements such as resistors and filter capacitors, these must be added in the substitution. The same is true of the replacements for either a-m or f-m transformers which contain special elements. We are referring particularly to units in which the trimmer capacitor is a combination element, part of it being used in the grid filter system of that stage. This may not become evident in a casual inspection of the device or the schematic, for the symbols representing the filter resistors and capacitors are not necessarily shown as a part of the trimmer. This calls for a careful examination of the transformer and the filter circuits. If the transformer is removed and with it all of the filter elements, then a substitution must consist of a corresponding number of units.

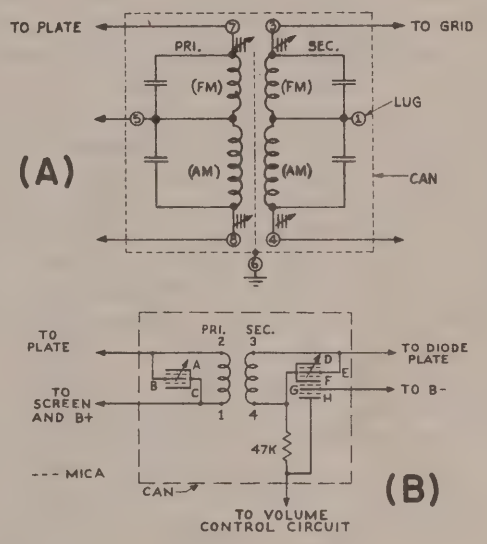



Fig. 1-15. (A) An i-f transformer of the dual-frequency variety found in a-m — f-m receivers. The a-m and f-m windings of the i-f transformer are in series and are contained in the same can; in (B) is shown a unit which contains, besides the i-f transformer, the filter capacitors and trimmers used in the associated circuit.

Relative to the general requirements of i-f transformers, those designed for use with pentodes will serve with any pentode or tetrode. The specific electrical characteristics of all pentode or tetrode i-f amplifiers are not alike, but the differences in i-f transformer performance due to this variable will not be significant if all other requirements are satisfied.

The intermediate frequency is another controlling factor in the selection of a substitute i-f transformer. Several broad categories exist, those used in a-m receivers, those in f-m receivers, and those in television receivers. In each group, the bandwidth requirement is pertinent to the selection of the replacement as is the specific intermediate frequency. Reference to the service data on the receiver is essential; the intermediate frequency used in a receiver does not dis-

close the specific bandwidth conditions in the i-f transformers. In some cases, all transformers are relatively broadband, being closely coupled. In other instances, the over-all broadbanding is accomplished by staggering the i-f peaks in the individual stages.

Concerning the center frequency, i-f transformers intended for a-m receivers have been standardized to four center frequencies, 130 kc, 175 kc, 262 kc, and 455 kc. From this point on, different types produced by different manufacturers afford different over-all frequency coverage. These vary from a low of about 5 per cent to a high of 40 per cent of the center frequency. For example, one manufacturer may produce an i-f transformer with a center frequency of 455 kc and an over-all tuning range of 50 kc, which is the equivalent of 25 kc each side of the rated center frequency. Some other manufacturer may design his transformers so that the over-all tuning range may be 200 kc, equal to about 40 per cent of the center frequency.

As a rule, the higher the center frequency, the wider is the over-all tuning range, but all makes of i-f transformers of like center frequency do not afford like frequency coverage. In other words, the selection of a transformer demands recognition of the bandwith requirements of the stage wherein it is to be used. Attention must also be paid to the tuning range of a unit if the intermediate frequency in the receiver is not the same as the center frequency of the transformer.

Concerning dual i-f transformers (a-m and f-m), the generally standardized frequencies found in the i-f systems of such receivers preclude any problems other than the one we referred to earlier, that is, to be certain that all of the filter components which exist inside of the original receiver manufacturer's unit appear in the receiver after the replacement has been made.

Up to this point we have neglected the factor of space relative to i-f transformer substitution. It can well be a problem. If the substitution is a transformer for a transformer, that is, single band for single band, it is not too difficult even if the substitute is larger than the original (which seldom is the case). If a dual band (single can) transformer must be replaced by two individual transformers, however, we have a problem. It is possible to find i-f transformers which are smaller than the usual variety. It takes effort to select the ones needed because several factors must be taken into account, but it can be done.

## Power-Transformer Substitutions

The physical size and the electrical ratings are two dominant factors in such substitutions. The limitations caused by size are so obvious as to require no elaboration. Concerning electrical ratings, the first essential is that the transformer afford the same over-all capabilities as the original, that is, its windings should be equal in number to that of the original so as to duplicate the functions of the original. This statement is subject to some slight qualifications which will appear when we discuss the filament windings, but in general, it can be said that the maximum convenience in substitution is attained if the substitute has at least as many different windings of like electrical rating as the original.

So far as physical characteristics are concerned, if the original transformer is shielded completely, the substitution unit should be likewise. If the original employs vertical shield mounting, so should the substitute; if the original has horizontal shield mounting, the replacement should duplicate it. Such attention to shielding will result in freedom from field troubles. Open-core transformers can cause trouble if located close to grid and plate wiring. If they must be used because the exact replacement is not available, the possibility of hum troubles must be recognized.

Each winding bears a voltage and a current rating with supplementary identification concerning the center tap. Although a center tap can be arranged by means of a center-tapped resistor connected across an untapped winding, it is preferable if the tap is a part of the winding. A suitable value for a resistor to be used for a center tap is 100 ohms.

*Increasing Heater Voltage Rating.* Although it is best if the filament windings on the transformer are the same in number and rating as the original, it is very possible that such replacements will not be available. In that event, the following information will be useful. Filament windings when connected in series furnishes a resultant voltage which is the sum of the voltage ratings of the individual windings. A 2.5-volt winding in series with another of 5.0 volts will be the equivalent of a voltage source rated at 7.5 volts. Care must be exercised to see that the two windings are connected with the windings aiding each other. An a-c voltmeter connected across the combined windings will indicate if they are aiding or bucking. The current rating of a series winding of this kind is limited to the lower of the two ratings of the individual windings.

For example, if two 6.3-volt windings, each rated at 1.2 amperes are connected in series aiding, the voltage rating of the two windings is 12.6 volts at 1.2 amperes. If one of these is rated at 0.9 ampere and the other at 1.5 amperes, the current output of the series winding would be limited to 0.9 ampere.

*Increasing Heater Current Rating.* Windings may be connected in parallel so as to increase the current output rating, provided that each of the windings connected in parallel is rated at the *same* value of voltage. The current ratings need not be the same; the total current output will be the sum of the two individual current ratings. Care must be exercised to see that the two windings are connected in proper phase, otherwise they will buck each other. An a-c voltmeter connected across one winding while the other is being connected

in parallel will show whether the phase is correct. If the voltage is reduced, they are bucking.

Relative to the center-tap connection, if two like voltage windings are connected in series, the junction between them can serve as the center tap; individual center taps on the two windings being disregarded. If two unlike voltage windings are connected in series, the midpoint of a 100-ohm resistor, shunted across the combined windings, can be used as the center tap.

If two windings are connected in parallel and each of them has a center tap, the two center taps may be connected together to serve as the combined center-tap connection. If only one of two windings in parallel has a center tap, it cannot be used as the center tap to serve both windings, a 100-ohm center-tapped resistor should be connected across the untapped winding and its midpoint joined to the other center tap, at which point the common connection can be made.

*Substitute Heater Windings.* If the replacement transformer does not contain all the required heater windings, a supplementary filament transformer, capable of furnishing the required voltage and current, can be used apart from the regular power transformer. Its primary should be connected in parallel with the other transformer.

Half-wave rectifier heater windings do not require center taps. Either end of the winding will serve as the positive output lead with a filament-type tube. Full-wave rectifiers should employ center-tapped heater windings even if the rectifiers are of the cathode type.

## Heater-Winding Insulation

As a rule, the voltage breakdown requirements of most heater windings which are a part of the power transformer can be satisfied by a rating of about 2,000 volts since the highest voltage in the system is far less than this amount. In cathode-ray equipment and other systems, it is possible that the cathode may be as much as 4,000 volts above ground and, since it is connected to the center tap of the heater winding, the latter is also above ground by the corresponding amount. This demands that the heater voltage winding be so insulated as to withstand this difference of potential. Sometimes (although very seldom), this requirement may be stated in the specifications. If it is not, it becomes the province of the technician to decide the voltage breakdown requirements of the heater winding.

## Rectifier Plate Windings

The conditions surrounding the selection of a substitute power transformer relative to the plate winding are varied, so much so, that it becomes necessary to examine several approaches to the subject. To begin with, the constants of a power transformer utilized in a receiver (or some other kind of equipment) may not be fully identified in service literature; a part number always is given, and sometimes, the current and voltage ratings of the heater windings are stated on the manufacturer's schematic. If this data is not given, the number required and the current rating of each become evident when reference is made to the schematic wiring diagram of the equipment in which the substitution is to be made. It discloses the number of heater or filament chains, and the voltage and current requirements of each. Summation of these indicates the minimum current ratings of the heater windings. The constants of the plate winding, however, are generally omitted. This means that some way must be found to ascertain the requirements of the plate winding so a proper substitute can be found in the event that an exact replacement from the original equipment manufacturer is not available.

The type of rectifiers and their ratings indicates the maximum voltage and current requirements of the plate winding. Seldom, if ever, are these tubes operated very close to their maximum ratings. Therefore, by noting the limits indicated in the tube characteristic chart, and the practical voltages being applied to the tubes in the system under consideration, it is possible to arrive at the voltage and current ratings of the plate winding. Whether it should be a full-wave winding, that is, center tapped, or a half-wave winding is indicated in the schematic of the equipment and by the organization of the rectifier system as a whole. But it is conceivable that there still may arise problems in establishing the voltage rating of the plate winding in view of the conditions experienced in choke- and capacitor-input filter systems, and because of the manner in which the parts catalogs describe the capabilities of the plate windings of power transformers. Generalizing, we can state that when the input of the power-supply filter system is capacitive, the voltage rating of each half of the power-supply plate winding in a full-wave system can be as much as 10 to 15 per cent lower than the d-c voltage output of the rectifier at the prescribed value of d-c load. This stems from the fact that the input filter capacitance can be charged to approximately the peak value of the a-c voltage applied to the rectifier tubes. Some parts catalogs state the voltage and current ratings based on full-wave operation of the rectifier with capacitance input, whereas many others show the a-c voltage across each half of the plate winding at certain d-c values in terms of choke input. This is a cause of confusion; in one case, the a-c voltage between the center tap and the extremes of the plate winding is less than the d-c voltage output from the rectifier by as much as 8 to 10 per cent, whereas in the other case, the a-c voltage rating of the plate winding may be as much as 10 to 15 per cent higher than the d-c voltage output from the rectifier.

What can be used as a guide in determining the basic requirements of the plate winding? The original

schematic of the equipment should be the first source of information, especially when it is supplemented by a voltage chart which indicates the voltages being supplied by the power supply. If the plate-current requirements of the tubes are not shown in the voltage chart, a reasonable approximation of these current values can be developed from the tube characteristic charts contained herein. Then, allowing for a 10 per cent voltage drop in the filter system of the power supply and perhaps a loss of about 5 per cent of the total output current through the bleeder connected across the power supply, one can arrive at the total current load requirements of the system and the maximum a-c voltage required between the center tap and the extremes of the full-wave plate winding.

These data are naturally subject to variations, but the approach we have described is not too far off the path which must be followed. At least it suggests a way to gather the necessary information.

It may appear, because of the large number of commercial models, that receivers and amplifiers are distinctive in their general requirements. Such is not the case, for all fall into certain groupings and reflect certain general design considerations. It would be foolish to deny that such circuits as shown in Rider Manuals can serve as the guide for substitution requirements. So far as tube heater and signal electrode voltages and currents are concerned, there isn't much difference between the five- or six-tube table models produced by different manufacturers. Individuality appears in the number of tubes, the specific designs of the transformers, the combination of functions and the like, but these play very little part in establishing the requirements of a power supply.

## Cathode-Ray-Tube Substitutions

Cathode-ray-tube substitutions are more involved than ordinary receiving tube substitutions, if for no other reason than that the physical dimensions of the various cathode-ray tubes differ, and the replacement of one by another may require substantial physical changes in the cabinet. Nevertheless, substitutions are possible and the following are offered as suggestions. They are to be used in conjunction with the cathode-ray-tube specifications contained in this Guide Book.

1. All picture tube phosphors must be number 4. This is the last digit in the tube type number.

2. Wholly electrostatically operated picture tubes must be replaced with similar tubes. Since these are restricted in screen size, replacement for 7- and 10-inch electrostatically deflected and focused picture tubes are very limited.

3. Tubes which employ magnetic deflection and electrostatic focusing have no substitutes among either completely electrostatic or magnetic types. The reverse is, of course, also true, a combination magnetic-deflection and electrostatic-focusing type tube cannot be a replacement for either an electrostatically or magnetically deflected and focused picture tube. Since the 7DP4, 9AP4, 10DP4, and 12AP4 are tubes of this type, they have no replacements except each other.

FOCUS COIL CURRENT RATINGS FOR MAGNETIC TYPE CATHODE-RAY TUBES

| C-R Tube | Focus Coil Current (Ma) | C-R Tube | Focus Coil Current (Ma) | C-R Tube | Focus Coil Current (Ma) |
|---|---|---|---|---|---|
| 10BP4, 10BP4A | 132 | 14CP4 | 115* | 16MP4, 16MP4A | 110 |
| 10CP4 | --- | 14DP4 | 104 | 16QP4 | 125* |
| 10DP4 | --- | 14FP4 | 115* | 16RP4 | 100* |
| 10EP4 | 132 | 15AP4 | 159 | 16SP4, 16SP4A | 110 |
| 10FP4 | 115 | 15CP4 | 133 | 16TP4 | 115* |
| 10MP4, 10MP4A | --- | 15DP4 | 140 | 16UP4 | 100* |
| 12JP4 | 158 | 16AP4, 16AP4A | 89 | 16VP4 | 110* |
| 12KP4, 12KP4A | 140 | 16CP4 | 110 | 16WP4 | 110* |
| 12LP4, 12LP4A | 114 | 16DP4, 16DP4A | 115* | 16XP4 | 100* |
| 12QP4, 12QP4A | 148 | 16EP4, 16EP4A | 105 | 16YP4 | 100* |
| 12RP4 | 148 | 16FP4 | 140 | 17AP4 | 115* |
| 12TP4 | 114 | 16GP4 | 100* | 19AP4, 19AP4A | 140 |
| 12UP4, 12UP4A | 114 | 16HP4, 16HP4A | 110 | 19DP4, 19DP4A | 140 |
| 12VP4, 12VP4A | --- | 16JP4, 16JP4A | 120 | 19EP4 | 140* |
| 14BP4 | 115 | 16KP4 | 97* | 19FP4 | 97-126* |
| | | 16LP4, 16LP4A | 110 | 19GP4 | 107-126* |
| | | | | 20BP4 | 122 |
| | | | | 22AP4, 22AP4A | 108* |

*** Types employ RTMA Focus Coil #109, all others RTMA focus focus coil #106.**

*Courtesy DuMont Labs*

4. Picture tubes differ in the focusing coil currents, consequently, in some instances the focusing coil for the substitute tube may require more current than for the original. This necessitates modification of the focusing current supply system. Conversely, some substitute tubes may require less current through the focusing coil than the original, in which case a resistor shunted across the coil will serve the purpose. This current shunt can be calculated using the d-c resistance of the focusing coil and the value of the current, just as in the case of heater current shunts. A variable resistance, 2,500-15,000 ohms, shunted across the coil can be used to determine the value for the fixed resistance shunt. The accompanying table lists the focusing-coil currents for the different magnetic-type cathode-ray tubes.

5. Replacing outside coated tubes with metal-cone types (or the reverse) requires care concerning the connection to the coating or the metal cone. The coating usually is connected to ground, whereas the metal cone usually is connected to a high voltage. The original receiver manufacturer's service notes must be consulted.

6. When a large tube is replaced by a smaller one, the characteristics of the substitute should be determined by reference to the characteristic chart; if the

conditions in the receiver exceed the maximum voltage ratings of the tube, these must be reduced in order to employ the substitute. Usually, those operations are too complicated for the average technician; such substitutions are not recommended.

7. All picture tubes do not utilize like tube basing. See the cathode-ray-tube basing chart in Section 5.

8. Bear in mind that the ion-trap magnets in magnetically focussed picture tubes are not all alike, some call for a single magnet, others for dual magnets; check the cathode-ray-tube characteristics in Section 5.

9. If tube characteristics indicate that the original tube has an external coating furnishing a certain amount of capacitance and the substitute tube does not, a corresponding value of capacitance should be added to the high-voltage power supply at the high-voltage output terminal. This capacitor must have the appropriate d-c working voltage rating.

10. If the ion-trap magnet for the original tube is of the electromagnetic type (coil) and the substitute utilizes a permanent magnet, the coil unit may be left intact (placed in a recess of the cabinet), or it may be replaced by an equivalent resistance of suitable wattage rating located as closely as possible to the power supply. It should not be disconnected without substituting the equivalent resistance into the current supply circuit.

# FUNCTIONAL CLASSIFICATION OF TUBES

| APPLICATION | | | HEATER VOLTAGES | | | | | 150 MILLIAMPERE HEATER CURRENT | 300 MILLIAMPERE HEATER CURRENT |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1.4 | 2.0 | 2.5 | 6.3 | 12.6 | | |
| RF - IF AMPLIFIERS | GENERAL PURPOSE | TRIODES | 26<br>957*<br>958* | 1H4G<br>30 | 27<br>56<br>485†† | 6AD4 7A4 XXL<br>6C4 37<br>6J4 76<br>6K4 955<br>6N4 9002 | 14A4 | 6AD4<br>6C4<br>955<br>9002 | 7A4<br>37<br>76 |
| | | DOUBLE TRIODES | 3B7/1291 | | 3B7/1291# | 6AH7GT 7F8<br>6J6<br>7AF7<br>7F7 | 12AH7GT 19J6##<br>12AT7<br>14AF7/XXD<br>14F7 | 12AH7GT 19J6<br>12AT7<br>14AF7/XXD<br>14F7 | 6AH7GT 12AT7<br>7AF7<br>7F7<br>7F8 |
| | | TETRODES | | 1A4T<br>1D5GT<br>1E5GT<br>32 | 24<br>35 | 36 | | | 36 |
| | | PENTODES | 1AB5**<br>1AD4<br>1AD5<br>1L4<br>1LC5<br>1LN5<br>1N5GT<br>1P5G<br>1P5GT<br>1SA6GT<br>1T4<br>1U4<br>1W5*<br>3E6<br>959* | 1A4P<br>1B4P<br>1D5GP<br>1E5GP<br>15<br>34 | 3E6#<br>57<br>58 | 6AG5 6K7 6U7G 954<br>6AH6 6K7G 6W7G 956<br>6AK5 6K7GT 7A7 9001<br>6AU6 6S7 7AB7 9003<br>6BA5 6S7G 7AD7<br>6BA6 6SD7GT 7AG7<br>6BC5 6SG7 7AJ7<br>6BD6 6SG7GT 7B7<br>6BH6 6SH7 7C7<br>6BJ6 6SH7GT 7G7<br>6C6 6SJ7 7H7<br>6CB6 6SJ7GT 7L7<br>6D6 6SK7 7V7<br>6E7 6SK7GT 39/44<br>6J7 6SS7 77<br>6J7G 6SS7GT 78<br>6J7GT | 12AU6 14H7<br>12AW6<br>12BA6<br>12BD6<br>12B7<br>12J7GT<br>12K7GT<br>12SG7<br>12SH7<br>12SH7GT<br>12SJ7<br>12SJ7GT<br>12SK7<br>12SK7GT<br>14A7/12B7<br>14C7 | 6BA5 12SG7<br>6BH6 12SH7<br>6BJ6 12SH7GT<br>6S7 12SJ7<br>6S7G 12SJ7GT<br>6SS7 12SK7<br>6SS7GT 12SK7GT<br>6W7G 14A7/12B7<br>7AB7 14C7<br>7B7 14H7<br>7C7 954<br>12AU6 956<br>12AW6 9001<br>12B7 9003<br>12BA6<br>12BD6<br>12J7GT<br>12K7GT | 6AU6 6SH7GT<br>6BA6 6SJ7<br>6BD6 6SJ7GT<br>6C6 6SK7<br>6D6 6SK7GT<br>6E7 6U7G<br>6J7 7A7<br>6J7G 7AG7<br>6J7GT 7AJ7<br>6K7 7H7<br>6K7G 7L7<br>6K7GT 39/44<br>6SD7GT 77<br>6SG7 78<br>6SG7GT<br>6SH7 |
| | TELEVISION | TRIODES | | | | 6AB4 | | 6AB4 | |
| | | DOUBLE TRIODES | | | | 6J6 12AT7 | 12AT7 19J6## | 12AT7 19J6 | 12AT7 |
| | | PENTODES | | | | 6AB7 6AK5 6BH6<br>6AC7 6AU6 6CB6<br>6AG5 6BC5 | 12AU6 | 6BH6<br>12AU6 | 6AG5<br>6AU6<br>6BC5<br>6CB6 |

* 1.25 V. ** 1.2 V. †† 3.0 V. # 2.8 V. ## 18.9 V.

*Courtesy TUNG-SOL Lamp Works, Inc.*

# FUNCTIONAL CLASSIFICATION OF TUBES

| APPLICATION | | HEATER VOLTAGES | | | | | | 150 MILLIAMPERE HEATER CURRENT | | 300 MILLIAMPERE HEATER CURRENT | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1.4 | 2.0 | 2.5 | 5.0 | 6.3 | 12.6 | | | | | |
| AF AMPLIFIERS | TRIODES | 1C3<br>1E4G<br>1G4GT<br>1LE3<br>26 | 1H4G<br>30 | 27<br>56<br>485†† | 01A | 6AE5GT<br>6AD5G<br>6AF5G<br>6C5<br>6C5GT<br>6F5<br>6F5G<br>6F5GT<br>6J5<br>6J5GT<br>6K5G<br>6K5GT<br>6L5G<br>6P5GT<br>6SF5<br>6SF5GT<br>7A4<br>7B4<br>37<br>56<br>75S<br>76 | 12E5GT<br>12F5GT<br>12J5GT<br>12SF5<br>12SF5GT<br>14A4 ... | 6L5G<br>12E5GT<br>12F5GT<br>12J5GT<br>12SF5<br>12SF5GT<br>14A4 | | 6AE5GT<br>6AF5G<br>6AD5G<br>6C5<br>6C5GT<br>6F5<br>6F5G<br>6F5GT<br>6J5<br>6J5GT<br>6K5G<br>6K5GT<br>6P5GT<br>6SF5<br>6SF5GT<br>7A4<br>7B4<br>37<br>56<br>75S<br>76 | |
| | DOUBLE TRIODES | | | 53 | | 6A6<br>6AE7GT<br>6C8G<br>6F8G<br>6N7<br>6N7G<br>6SC7<br>6SC7GT<br>6SL7GT<br>6SN7GT<br>6Y7G<br>6Z7G<br>7AF7<br>7F7<br>12AU7<br>12AX7<br>12AY7<br>79 | 12AU7<br>12AX7<br>12AY7<br>12SC7<br>12SL7GT<br>12SN7GT<br>14AF7<br>14F7<br>14F7 | 12AU7<br>12AX7<br>12AY7<br>12SC7<br>12SL7GT<br>14AF7<br>14F7 | | 6C8G<br>6SC7<br>6SL7GT<br>6Z7G<br>7F7<br>12AU7<br>12AX7<br>12AY7<br>12SN7GT | |
| | TETRODES | | 32 | 24 | | 36 | | | | 36 | | |
| | PENTODES | 1L4<br>1LG5<br>1U4<br>959• | 1B4P<br>1E5GP<br>15 | 57 | | 6AU6<br>6BA5<br>6BH6<br>6C6<br>6J7<br>6J7G<br>6J7GT<br>6R6G<br>6SG7<br>6SG7GT<br>6SH7<br>6SH7GT<br>6SJ7<br>6SJ7GT<br>6W6GT<br>6W7G<br>7AB7<br>7AG7<br>7AH7<br>7C7<br>7E5<br>7G7<br>7L7<br>7T7<br>7V7<br>7W7<br>77<br>717A<br>954<br>956<br>9001<br>9003 | 12AU6<br>12J7GT<br>12SH7<br>12SH7GT<br>12SJ7<br>12SJ7GT<br>14C7<br>14V7 | 6BH6<br>6W7G<br>7AG7<br>7AH7<br>7C7<br>7E5<br>12AU6<br>12J7GT<br>12SH7<br>12SH7GT<br>12SJ7<br>12SJ7GT<br>14C7<br>954<br>956<br>9001<br>9003 | | 6AU6<br>6C6<br>6J7<br>6J7G<br>6J7GT<br>6R6G<br>6SG7<br>6SG7GT<br>6SH7<br>6SH7GT<br>6SJ7<br>6SJ7GT<br>7L7<br>7T7<br>7W7<br>77 | |
| INDICATORS | TUNING INDICATORS | | | 2E5<br>2G5 | | 6AB5/6N5<br>6AD6G<br>6AF6G<br>6AL7GT<br>6E5<br>6G5<br>6T5<br>6U5/6G5 | | 6AL7GT | | 6E5<br>6G5<br>6T5<br>6U5/6G5 | | |
| | INDICATOR CONTROL | | | | | 6AE6G | | 6AE6G | | | | |

†† 3.0 V. • 1.25 V.

*Courtesy TUNG-SOL Lamp Works, Inc.*

# FUNCTIONAL CLASSIFICATION OF TUBES

| APPLICATION | | | HEATER VOLTAGES | | | | | | | | | | 150 MILLI-AMPERE HEATER CURRENT | 300 MILLI-AMPERE HEATER CURRENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1.4 | 2.0 | 2.5 | 5.0 | 6.3 | 12.6 | 18.9 | 25 | 35 | 50 | | |
| POWER AMPLIFIERS | GENERAL PURPOSE | TRIODES | | 1H4G<br>30<br>31 | 2A3<br>45 | 01A<br>12A<br>71A<br>183 | 6A3 50†<br>6A5G<br>6AC5GT<br>6B4G<br>6C4 | | | 25AC5GT | | | | 25AC5GT |
| | | DOUBLE TRIODES | 1G6GT<br>3C6/XXB | 1J6G<br>19 | 53<br>3C6/XXB# | | 6A6 6Y7G<br>6AS7G 6Z7G<br>6E6 79<br>6N7<br>6N7GT | | | | | | | 6Z7G |
| | | TETRODES | | 49 | 46 | | 6AL6G | | | | | | | |
| | | PENTODES | 1A5GT 3LE4<br>1AC5 3LF4<br>1C5GT 3V4<br>1LA4 3C5GT<br>1LB4 3Q4<br>1S4 3S4<br>1V5*<br>1W4<br>3A4<br>3D6 | 1F4<br>1F5G<br>1G5G<br>1J5G<br>33<br>950 | 2A5<br>3A4#<br>3C5GT#<br>3LE4#<br>3Q4<br>3S4#<br>3V4#<br>47<br>59 | 257 | 6A4/LA 6R6G<br>6AG7 7B5<br>6AK6 38<br>6AN5 41<br>6AR5 42<br>6F6 89<br>6F6G<br>6F6GT<br>6G6G<br>6K6GT | 12A5 | | 25A6<br>25A6GT<br>25B6G<br>43 | | | 6AK6<br>6G6G | 6A4/LA<br>12A5<br>25A6<br>25A6GT<br>25B6G<br>38<br>43 |
| | | BEAM PENTODES | 1Q5G<br>1Q5GT<br>1T5GT<br>3B5GT<br>3LF4<br>3Q5GT | | 3B5GT#<br>3LF4#<br>3Q5GT# | | 6AH5G 6V5GT<br>6AQ5 6V6<br>6AR6 6V6GT<br>6AS5 6W6GT<br>6L6 6Y6G<br>6L6G 7A5<br>6L6GA 7C5<br>6U6GT | 12A6<br>12A6GT<br>14A5<br>14C5<br>1625 | | 25C6G<br>25L6<br>25L6GT | 35L6GT<br>35A5<br>35B5<br>35C5 | 50A5<br>50B5<br>50C5<br>50C6G<br>50L6GT | 12A6 50L6GT<br>12A6GT<br>14A5<br>35A5<br>35C5<br>35C6GT<br>50B5<br>50C5<br>50C6G | 25C6G<br>25L6<br>25L6GT |
| | | DOUBLE PENTODES | | 1E7G | | | | 12L8GT | | | | | 12L8GT | |
| | | DIRECT COUPLED | | | | | 6AB6G 6B5<br>6AC6GT 6N6G | | | 25B5<br>25N6GT | | | | 25B5<br>25N6G |
| | TELEVISION HORIZONTAL DEFLECTION | BEAM PENTODES | | | | | 6AU5GT 6BQ6GT<br>6AV5GT 6CD6G<br>6BG6G | | 19BG6G | 25BQ6GT | | | | 19BG6G<br>25BQ6GT |
| | TELEVISION VERTICAL DEFLECTION | TRIODES OR TRIODE CONNECTED PENTODES | | | | | 6AR5<br>6K6GT<br>6S4<br>6SN7GT<br>6W6GT<br>12AU7 | 12AU7<br>12SN7GT | | | | | 12AU7 | 12AU7<br>12SN7GT |

* 1.25 V. # 2.8 V. † 7.5 V.

Courtesy TUNG-SOL Lamp Works, Inc.

# FUNCTIONAL CLASSIFICATION OF TUBES

**MULTI-FUNCTION TUBES**

| APPLICATION | HEATER VOLTAGES | | | | | | | | | 150 MILLIAMPERE HEATER CURRENT | 300 MILLIAMPERE HEATER CURRENT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.4 | 2.0 | 2.5 | 6.3 | 12.6 | 25 | 35 | 70 | 117 | | |
| GATED BEAM DEFLECTION | | | | 6BN6 | 12BN6 | | | | | 12BN6 | 6BN6 |
| DIODE TRIODES | 1H5G<br>1H5GT<br>1LH4 | | | 6Q6G | | | | | | 6Q6G | |
| DOUBLE-DIODE TRIODES | | 1B5/25S<br>1H6G | 2A6<br>55 | 6AQ6 6C7 6SR7GT<br>6AQ7GT 6Q7 6ST7<br>6AT6 6Q7G 6SZ7<br>6AV6 6Q7GT 6T7G<br>6AW7GT 6R7 6V7G<br>6B6G 6R7G 7B6 75<br>6BF6 6R7GT 7C6 85<br>6BK6 6SQ7 7E6<br>6BT6 6SQ7GT 7K7<br>6BU6 6SR7 7X7 | 12AT6 12SR7GT<br>12AV6 12SW7<br>12BF6 14B6<br>12BK6 14E6<br>12BT6 14X7<br>12BU6<br>12Q7GT<br>12SQ7<br>12SQ7GT<br>12SR7 | | | | | 6AQ6 12BU6<br>6ST7 12Q7GT<br>6SZ7 12SQ7<br>6T7G 12SQ7GT<br>7C6 12SR7<br>12AT6 12SR7GT<br>12AV6 12SW7<br>12BF6 14B6<br>12BK6 14E6<br>12BT6 14X7 | 6AQ7GT 6Q7G 7B6<br>6AT6 6Q7GT 7E6<br>6AV6 6R7 7K7<br>6AW7GT 6R7G 7X7<br>6BF6 6R7GT 75<br>6BK6 6SQ7 85<br>6BT6 6SQ7GT<br>6BU6 6SR7<br>6C7 6SR7G<br>6Q7 6V7G |
| TRIPLE-DIODE TRIODES | | | | 6R8 6T8<br>6S8GT | 12S8GT | 19T8## | | | | 12S8GT<br>19T8 | 6S8GT |
| DIODE PENTODES | 1LD5<br>1Q6•<br>1S5<br>1SB6GT<br>1T6•<br>1U5 | | | 6SF7<br>6SF7GT<br>6SV7 | 12SF7GT | | | | | 12SF7GT | 6SF7<br>6SV7 |
| DIODE POWER PENTODES | 1N6G<br>1N6GT | | | | | | | | | | |
| DOUBLE-DIODE PENTODES | 1F6<br>1F7G<br>1F7GH | | 2B7 | 6B7 6B8GT<br>6B8 7E7<br>6B8G 7R7 | 12C8<br>14E7<br>14R7 | | | | | 12C8<br>14E7<br>14R7 | 6B7 6B8GT<br>6B8 7E7<br>6B8G 7R7 |
| TRIODE PENTODES | | | | 6AD7G 6F7G<br>6F7 6P7G | 12B8GT | 25B8GT | | | | 25B8GT | 6F7 6P7G<br>6F7G 12B8GT |
| DIODE TRIODE PENTODES | 1B8GT<br>1D8GT<br>3A8GT | | 3A8GT# | | | 25D8GT | | | | 25D8GT | |
| HALF-WAVE RECTIFIERS POWER PENTODES | | | | | 12A7 | 25A7GT | | | | | 12A7<br>25A7GT |
| HALF-WAVE RECTIFIERS BEAM PENTODES | | | | | | | 32L7GT• | 70A7GT<br>70L7GT | 117L7/M7GT<br>117N7GT<br>117P7GT | 70A7GT<br>70L7GT | 32L7GT |

• 1.25 V. # 2.8 V. ## 18.9 V. • 32.5 V.





*Courtesy TUNG-SOL Lamp Works, Inc.*

# FUNCTIONAL CLASSIFICATION OF TUBES

| APPLICATION | | | HEATER VOLTAGES | | | | | | | | | | 150 MILLIAMPERE HEATER CURRENT | 300 MILLIAMPERE HEATER CURRENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1.4 | 2.0 | 2.5 | 5.0 | 6.3 | 12.6 | 25 | 35 | 50 | 117 | | |
| CONVERTERS | GENERAL PURPOSE | PENTAGRID HEPTODE OCTODE | 1A7G 1L6<br>1A7GT 1LA6<br>1B7G 1LC6<br>1B7GT 1R5<br>1E8 | 1A6<br>1C6<br>1C7G<br>1D7G | 2A7 • | | 6A7 6SA7<br>6A8 6SA7GT<br>6A8G 6SB7Y<br>6A8GT 7A8<br>6BA7 7B8<br>6BE6 7Q7<br>6D8G | 12A8GT 12SY7<br>12BA7 12SY7GT<br>12BE6 14B8<br>12SA7 14Q7<br>12SA7GT | | | | | 6D8G 12SY7<br>7A8 12SY7GT<br>12A8GT 14B8<br>12BA7 14Q7<br>12SA7GT | 6A7 6SA7<br>6A8 6SA7GT<br>6A8G 6SB7Y<br>6A8GT 7B8<br>6BA7 7Q7<br>6BE6 |
| | | TRIODE HEXODES<br>TRIODE HEPTODES | | | | | 6J8G<br>6K8<br>6K8G<br>6K8GT<br>7D7<br>7J7<br>7S7 | 12K8<br>12K8GT<br>14J7<br>14S7 | | | | | 7D7<br>12K8<br>12K8GT<br>14J7<br>14S7 | 6J8G<br>6K8<br>6K8G<br>6K8GT<br>7J7<br>7S7 |
| | | MIXERS | | | | | 6AS6<br>6L7<br>6L7G | | | | | | | 6L7<br>6L7G |
| | TELEVISION | DOUBLE TRIODE MIXERS | | | | | 6J6 12AT7 | 12AT7 | | | | | 12AT7 | 12AT7 |
| | | PENTODE MIXERS | | | | | 6AG5<br>6AK5<br>6BC5<br>6CB6 | | | | | | | 6AG5<br>6BC5<br>6CB6 |
| RECTIFIERS | GENERAL PURPOSE — HIGH VACUUM | HALF-WAVE DIODES | | | 2W3<br>2W3GT<br>2Y2<br>2Z2 | | 1-V<br>81† | 12Z3 | 25W4GT | 35W4<br>35Y4<br>35Z4GT<br>35Z5GT | 45Z3••<br>45Z5GT•• | 117Z3<br>117Z4GT | 35Y4<br>35Z3<br>35Z4GT<br>35Z5GT<br>45Z5GT | 1-V<br>1Z2<br>12Z3<br>25W4GT |
| | | FULL-WAVE DOUBLE DIODES | | | | 5AZ4 5X4G<br>5R4GY 5Y3G<br>5T4 5Y3GT<br>5U4G 5Y4G<br>5V4G 5Y4GT<br>5W4G 5Z3<br>5W4GT 5Z4<br>5X3 80<br>83V | 6AX5GT 7X6<br>6W5G 7Y4<br>6X4 7Z4<br>6X5 84/6Z4<br>6X5GT<br>6Y5<br>6Z5/12Z5<br>6ZY5G | 6Z5/12Z5 | 25Z5<br>25Z6<br>25Z6GT | 35Z6G | 50X6GT<br>50Y6GT<br>50Y7GT<br>50Z7G | 117Z6GT | 50Y6GT<br>50Y7GT<br>50Z7G | 6ZY5G<br>25Z5<br>25Z6<br>25Z6GT<br>35Z6G |
| | | DETECTORS DIODES | 1A3<br>1R4/<br>1294<br>2B25 | | 9005• | | 6H4GT<br>7C4/1203A<br>9004<br>9006 | | | | | | 1A3 9004<br>1R4 9006<br>6H4GT<br>7C4/1203A | |
| | | DOUBLE DIODES | | | | | 6AL5 7A6<br>6H6<br>6H6GT | 12AL5<br>12H6 | | | | | 7A6<br>12AL5<br>12H6 | 6AL5<br>6H6<br>6H6GT |
| | | QUADRUPLE DIODES | | | | | 6AN6 | | | | | | | |
| | VOLTAGE DOUBLER | DOUBLE DIODE | | | | | | | 25Z5<br>25Z6<br>25Z6GT | 35Z6G | 50X6<br>50Y6GT<br>50Y7GT<br>50Z7G | 117Z6GT | 50X6<br>50Y6GT<br>50Y7GT<br>50Z7G | 25Z5<br>25Z6<br>25Z6GT<br>35Z6G |

• 3.6 V. † 7.5 V. •• 45 V.

Courtesy TUNG-SOL Lamp Works, Inc.

# FUNCTIONAL CLASSIFICATION OF TUBES

| APPLICATION | | | | HEATER VOLTAGES | | | | | | | 150 MILLIAMPERE HEATER CURRENT | 300 MILLIAMPERE HEATER CURRENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | COLD CATHODE | 1.4 | 2.5 | 5.0 | 6.3 | 12.6 | 25 | | |
| RECTIFIERS | TELEVISION — HIGH VACUUM | HIGH VOLTAGE | DIODES | | 1B3GT<br>1X2<br>1V2<br>1Y2<br>1Z2 | 2V3G<br>2X2<br>2X2/879<br>879 | | | | | | |
| | | VIDEO DETECTOR | DOUBLE DIODES | | | | | 6AL5 | 12AL5 | | 12AL5 | 6AL5 |
| | | DAMPER SERVICE | DIODES | | | | 5V4G | 6U4GT<br>6W4GT | | 25W4GT | | 25W4GT |
| | | | DIODE CONNECTED | | | | | 6AS7G | | | 6AS7G | |
| | | DC RESTORER | DOUBLE DIODE | | | | | 6AL5 | 12AL5 | | 12AL5 | 6AL5 |
| | GENERAL PURPOSE—GAS | HALF WAVE | DIODES | 0Y4<br>0Y4G | | | | | | | | |
| | | FULL WAVE | DOUBLE DIODE | 0Z4<br>0Z4G | | 82<br>83 | | | | | | |
| VOLTAGE REGULATOR | | | GLOW DISCHARGE DIODE | 0A2<br>0A3/VR-75<br>0B2<br>0B3/VR-90<br>0C3/VR-105<br>0D3/VR-150 | | | | | | | | |
| CONTROL SERVICE | | | GAS TRIODE | 1C21 | | 2A4G<br>2B4<br>2C4<br>885 | | 6D4<br>6Q5G<br>884 | | | | |
| | | | GAS TETRODES | | | | | 2D21<br>2050<br>2051 | | | | |
| | | | RELAY TUBE | 0A5 | | | | | | | | |

*Courtesy TUNG-SOL Lamp Works, Inc.*

# SECTION 2

## RECEIVING TUBE SUBSTITUTION GUIDE

This section includes the actual information on the tube substitutions. Four columns are included. The first column lists the tube type for which a substitute is desired. This listing is in numerical and alphabetical order. For example 6CB6 precedes 6CD6 and 6ZY5 precedes 7A4. We have not indicated any difference between metal and glass tubes of the octal type. The tube listed can thus be considered either as metal or a glass type. The letters *G, GT, GT/G, GA,* or *GP* indicates that the tube has a glass envelope, the *GT* and *GT/G* are smaller and newer versions of the *G* type. The glass tubes, in practically all cases, have the same characteristics as the metal types.

One of the primary differences between the glass and metal tubes is that the metal type usually have an internal shield. A pin at the base of these tubes is connected to this shield. In most cases this pin is wired to the common ground or B minus of the set. In a few cases substituting a glass type for a metal type causes the circuit to become unbalanced or feedback occurs due to a lack of proper shielding. Most often this can be overcome by shielding the tube or realigning the set.

The second column lists the various possible substitutes. Quite often more than one substitute is listed for a single tube. In such cases the tube in the first column is not repeated for each substitute but is listed only once.

The third column lists the performance of each tube. Three performance ratings are shown in this list. These are *E* for EXCELLENT, *G* for GOOD, and *P* for POOR. They define the suitability of a substitute predicated upon its electrical characteristics as compared to those of the original and upon the relationship between the characteristics of the substitute to the constants of the circuit, which was designed to function best with the original. The comparison between the characteristics of the tubes excludes the filament or heater voltage and current ratings. It is assumed that whatever may be the performance characteristics of the substitute — the filament or heater voltages and current are correct, even if it requires certain minor circuit modifications to accomplish this condition.

Concerning the *E, G,* and *P* ratings, it stands to reason that those tubes which bear *E* (excellent) ratings are either the exact equivalents differing perhaps in basing and maybe in filament or heater voltage and current ratings — or so closely approximate the electrical characteristics of the original as to require no significant major modifications. All applicable tube substitutions which might bear an *E* rating in performance are not shown in the main listing. Some appear on the addendum pages. These represent last-minute additions as the result of information received from television receiver manufacturers and appear at the end of this section.

Concerning the *G* (good) rating, it reflects more than just moderate differences in tube characteristics between the substitute and the original that is being replaced. It still means a triode substitute for a triode original, or a pentode substitute for a pentode original, and sometimes the conversion of a pentode into a triode, but the plate (and screen) voltage demands of the substitute may be higher than that of the original — or the transconductance or amplification constant of the substitute may be less than the original — all of which means that the circuit demands incorporated in the equipment design are not being met by the substitute tube. Possibly the plate impedance of the substitute is higher or lower, reducing the originally intended over-all amplification; perhaps a slight amount of distortion is added to the signal by the substitute. Yet the substitute may be used even if it is not as good in performance as the original, for again it is a matter of continuing the operation of a device.

Those substitutions which bear *P* (poor) ratings are used only as a last resort. They represent the extremes in tube substitution when it is a matter of accomplishing a repair job of sorts, rather than none at all because more appropriate substitutes are not available. Of course, modifications can be made in the circuit design and circuit constants so as to accommodate the tube rated poor, in which case, considerable improvement may be accomplished. It must be remembered, of course, that the *P* rating — or for that matter, the *G* rating — is not a reflection upon the capabilities of the tube or the brand. It simply means that the tube, so designated in the list, was not intended for use in the type of system for which it is suggested as a substitute. With proper circuit changes, it might, as we said before, become a better performing substitute. But whether or not such design changes are warranted is a matter of individual consideration. As

far as circuit modification is concerned, it can be a tedious task. Much depends upon comparative reference data and background knowledge of circuits. Finally such changes are possible only if the cost is acceptable to the owner of the equipment.

The fourth or last column lists the circuit changes that are necessary to make the substitute operate properly. In many cases no change whatsoever is required, the original tube is pulled out and the substitute plugged in. Where the reference "parallel circuits only" or "series circuits only" is found, it refers only to the type of filament circuit arrangement in which the substitute tube can be used.

## Original and Substitute Sockets

The tube substitution lists contain illustrations of the original and the substitute tube sockets when the tube interchange involves a change in sockets. These are offered as a convenience in wiring. The views are the bottoms of the sockets and these correspond to the pin locations on the bottom of the respective tube bases. The bottom socket view of the original tube will always be found to the left of the change writeup and will bear the designation "ORIG." The bottom socket view of the substitute tube will always be found to the right of the change writeup and will bear the designation "SUB."

The instructions given between the two illustrations state the respective socket terminals involved in the rewiring operation. In view of the necessity for removing one socket before mounting the other, it is suggested that as each wire is disconnected from the original socket, it be labeled with a tiny tag showing the appropriate socket connection number. These correspond to the pin numbers on the tube base. Then when being rewired to the new socket, all that is required is to solder the numbered lead to the terminal on the socket as stated in the instructions.

Care must be exercised to see that the socket connections are read in accordance with the location of the key as shown on the pages. In order to attain correspondence between the socket mounted on the chassis and the instructions, one or the other should be changed in physical position so that the keys or identifying terminals are in the same relative position. Another precautionary note relates to the grid caps. In many cases capped tubes are replaced by single ended tubes, and vice-versa. The leads must be properly connected. Finally in some substitutions the pin numbers on the original and the substitute are the same, that is, 1 to 1, 2 to 2, 3 to 3 and so on. This is not standard for all the tubes, nor is it standard for all the pins even if it is true for some of them in any one substitution. In other words, the instructions should be read completely. Nothing should be taken for granted.

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| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 00A | 01A | E | No changes. |
| | 40 | G | |
| 01A | 00A | E | No changes. |
| | 00AA | E | |
| | 01B | E | |
| | 40 | G | |
| 0A2 | 0B2 | P | Where application is not too critical. No changes. |
| 0A3 | VR75 | E | No changes. |
| 0A4 | 1267 | E | No changes. |
| 0B2 | 0C3 | E | Where space permits. Change socket to octal and rewire as follows: |

| | | | |
|---|---|---|---|
| No. 1 on miniature | to No. | 5 on octal | |
| 2 | to | 2 | |
| 5 | to | 5 | |
| 4, 7 | to | 2 | |

| | | | |
|---|---|---|---|
| 0B3 | VR90 | E | No changes. |
| 0C3 | VR105 | E | No changes. |
| | 0B2 | E | Reverse 0B2 to 0C3 procedure. |
| 0D3 | VR150 | E | No changes. |
| 0Y4 | 0Y4G | E | No changes. |
| 0Y4G | 0Y4 | E | Ground pin No. 1 |
| 0Z4 | 0Y4 | G | No changes. |
| | 0Z4A/1003 | E | |
| | 1005/CK1005 | E | |
| | 6X5 | E | Solder socket terminal No. 2 to chassis. Connect 6V hot lead to No. 7. Motorolas and some other car radios have filament wired and the 6X5 may be used without making any changes. |
| | 7Y4 | E | Change socket to loctal and rewire as follows: |

| | | | |
|---|---|---|---|
| No. 3 on octal | to No. | 3 on loctal | |
| 5 | to | 6 | |
| 8 | to | 7 | |

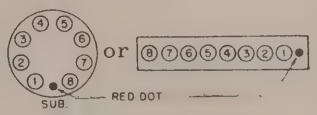
Connect No. 8 on loctal to chassis and No. 1 on loctal to 6V hot lead.

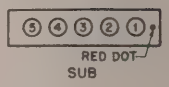
| | | | |
|---|---|---|---|
| | 84 | E | Reverse 84 to 6X5 procedure. |
| 0Z4A | 0Y4 | G | No changes. |
| | 1005/CK1005 | G | |
| | 1003 | E | |
| 1A3 | 1R4/1294 | E | Where space permits. Change socket to loctal and rewire as follows: |

| | | | |
|---|---|---|---|
| No. 1 on miniature | to No. | 1 on loctal | |
| 2 | to | 4 | |
| 3 | to | 7 | |
| 6 | to | 4 | |
| 7 | to | 8 | |

| | | | |
|---|---|---|---|
| 1A4 | 1B4 | E | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1A4 | 1D5 | E | Change socket to octal and rewire as follows: |
| | 1E5 | E | No. 1 on four prong to No. 2 on octal; 2 to 3; 3 to 4; 4 to 7; cap to cap |
| | 32 | E | No changes. |
| | 34 | E | |
| 1A5 | 1C5 | G | Parallel circuits only. No changes. |
| | 1G4 | P | No changes. Emergency but works well in most cases. |
| | 1LA4 | E | Change socket to loctal and rewire as follows: |
| | 1LB4 | E | No. 2 on octal to No. 1 on loctal; 3 to 2; 4 to 3; 5 to 6; 7 to 8 |
| | 1N6 | P | Remove and tape up any wires anchored on No. 6. |
| | 1Q5 | P | Parallel circuits only. No changes. |
| | 1S4 | P | Same as 3Q5 to 3S4, except do not connect No. 8 on octal to No. 5 on miniature. Parallel circuits only. |
| | 1T4 | P | Emergency substitution. Tone OK at low volume. Change socket to miniature and rewire as follows: |
| | | | No. 2 on octal to No. 1 on miniature; 3 to 2; 4 to 3; 5 to 6; 7 to 7 |
| | 1T5 | G | No changes. Filament current 10 mils higher but gives satisfactory results. |
| | 3Q4 | P | Electric operation only. Same as 3Q5 to 3S4, except connect nothing to No. |
| | 3S4 | | 5 on miniature. |
| | 3Q5 | P | No changes necessary. For electric operation only as the A battery will be too low with 1.4 more filament in the circuit. |
| 1A6 | 1C6 | E | No changes. For parallel operation only as the 1C6 draws 120 mils instead of 60. |
| | 1C7 | E | Parallel circuits only. Change socket to octal and rewire as follows: |
| | | | No. 1 on six prong to No. 2 on octal; 2 to 3; 3 to 6; 4 to 5; 5 to 4; 6 to 7 |
| | 1D7 | E | Same as 1A6 to 1C7. Either series or parallel circuits. |
| 1A7 | 1B7 | E | Parallel circuits only. No changes. |
| | 1C7 | P | Parallel circuits only. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1A7 | 1D7 | P | No changes, unless there is a resistor across 1A7 filament, which must be removed. 1D7 is rated 2V 60 mils and draws slightly less than 50 on 1.4. |
| | 1L6 | G | Same as 1A7 to 1U6. |
| | 1LA6<br>1LC6 | E<br>E | Change socket to loctal and rewire as follows:<br>No. 2 on octal to No. 1 on loctal<br>3 to 2<br>6 to 3<br>5 to 4<br>4 to 5<br>7 to 8<br>cap to 6<br> <br> |
| | 1R5 | G | Make adaptor as follows: Solder rather heavy wires three inches long to all lugs except No. 5 of miniature socket. Break the 1A7, clean out the base and save the cap. Push the wires from miniature socket thru the base pins as follows:<br>No. 1 on miniature thru No. 2 of base<br>2 thru 3<br>3 thru 6<br>4 thru 5<br>7 thru 7<br>6 bring out and solder grid cap on.<br><br>The octal socket could be replaced by a miniature using the above connections but it is usually hard to find a place to mount it.<br><br>If 1R5 squeals, reduce value of oscillator grid resistor to 75000 ohms or less if necessary. This resistor is connected between terminal No. 5 on the the 1A7 socket and ground or filament.<br><br>An idea we have been using successfully is to dig a trough from pin No. 5 to pin No. 7 on the adaptor, filling this with the graphite preparation made for volume controls, measuring the resistance, and filling the trough until the desired resistance is acquired. |
| | 1U6 | G | Parallel circuits only. Change socket to miniature and rewire as follows:<br>No. 2 on octal to No. 1 on miniature<br>3 to 2<br>4 to 5<br>5 to 4<br>6 to 3<br>7 to 7<br>cap to 6<br> <br> |
| 1AB5 | 1AD5 | G | Parallel circuits only. Change socket to subminiature and rewire as follows:<br>No. 1 on loctal to No. 4 on subminiature<br>2 to 7<br>3 to 8<br>6 to 2<br>7 to 5<br>8 to 5<br> <br>  |
| 1AC5 | 1V5 | E | No changes. |
| 1AD4 | 1AD5 | G | Parallel circuits only. **Reverse** 1AD5 to 1AD4 **procedure.** |
| | 1AE4 | G | Reverse 1AE4 to 1AD4 procedure. |
| 1AD5 | 1AB5 | G | Parallel circuits only. Reverse 1AB5 to 1AD5 procedure. |

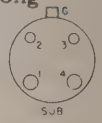
| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1AD5 | 1AD4 | G | Parallel circuits only. |
| | 1W5 | E | No changes. |
| 1AE4 | 1AD4 | G | Change socket to subminiature and rewire as follows:<br>No. 1 on miniature to No. 5 on 1AD4<br>2 to 1<br>3 to 2<br>5 to 5<br>6 to 4<br>7 to 3<br> <br>  <br>Pin numbers on 1AD4 number from right to left from red mark on base, as shown. |
| 1AF4 | 1AF5 | P | Rewire as follows:<br>No. 5 to No. 1<br>2 to 5<br>3 to 4<br>Do not use terminal No. 3 for anchor |
| | 1L4 | G | No changes. Parallel circuits only. |
| | 1T4 | P | |
| | 1U4 | G | |
| 1AF5 | 1LD5 | G | Parallel circuits only. Where space permits. Change socket to loctal and rewire as follows:<br>No. 1 on miniature to No. 1 on loctal<br>3 to 4<br>4 to 3<br>5 to 2<br>6 to 6<br>7 to 8<br> <br> |
| | 1S5 | G | Parallel circuits only. No changes. |
| 1B3 | 1X2 | P | Reverse 1X2 to 1B3 procedure. |
| 1B4 | 1A4 | E | No changes. |
| | 1D5 | E | Same as 1A4 to 1D5. |
| | 1E5 | E | |
| | 32 | E | No changes. |
| | 34 | E | |
| 1B5 | 1H6 | E | Change socket to octal and rewire as follows:<br>No. 1 on six prong to No. 2 on octal<br>2 to 3<br>3 to 4<br>4 to 5<br>5 to 6<br>6 to 7<br> <br> |
| | 25S | E | No changes. |
| 1B7 | 1A7 | E | Parallel circuits only. No changes. |
| | 1L6 | G | Parallel circuits only. Same as 1A7 to 1U6 |
| | 1LA6 | E | Parallel circuits only. Same as 1A7 to 1LA6. |
| | 1LC6 | E | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1B7 | 1R5 | G | Parallel circuits only. Same as 1A7 to 1R5. |
| | 1U6 | G | Parallel circuits only. Same as 1A7 to 1U6. |
| 1B8 | 1D8 | E | No changes. |
| 1C3 | 1G4 | G | Where space permits. Change socket to octal and rewire as follows:<br> <br><br>No. 1 on miniature to No. 2 on octal<br>2 to 3<br>4 to 5<br>6 to 3<br>7 to 7<br> <br> |
| | 1LE3 | G | Where space permits. Change socket to loctal and rewire as follows:<br> <br><br>No. 1 on miniature to No. 1 on loctal<br>2 to 2<br>4 to 6<br>6 to 2<br>7 to 8<br> <br> |
| 1C5 | 1A5 | G | Parallel circuits only. No changes. |
| | 1D8 | P | Remove and tape up any wires connected to 6 and 8. No connection to top cap. |
| | 1LA4 | G | Same as 1A5 to 1LA4. Parallel circuits only. |
| | 1LB4 | G | |
| | 1Q5 | G | No changes. Bias different but tone is reasonably good. |
| | 1S4 | G | Same as 3Q5 to 3S4, but connect nothing to No. 5 on miniature. |
| | 1T5 | G | Parallel circuits no changes. Series circuits shunt 35 ohm resistor across filament. |
| | 3Q4 | P | Change socket to miniature and rewire as follows: |
| | 3S4 | P | <br><br>No. 2 on octal to No. 5 on miniature<br>3 to 2<br>4 to 4<br>5 to 3<br>7 to 1 and 7<br> <br> |
| | 3Q5 | P | Same as 1Q5 to 3Q5. |
| 1C6 | 1A6 | G | Parallel circuits only. No changes. |
| | 1C7 | G | Same as 1A6 to 1C7. Either series or parallel circuits. |
| | 1D7 | G | Same as 1A6 to 1C7. Parallel circuits only. |
| 1C7 | 1A6 | G | Reverse 1A6 to 1C7 procedure. Parallel circuits only. |
| | 1C6 | E | Reverse 1A6 to 1C7 procedure. |
| | 1D7 | E | Parallel circuits only. No changes. |
| 1C8 | 1AE5 | G | Parallel circuits only. |
| | 1E8 | E | No changes. |
| 1C21 | | | No practical substitute. |

# RECEIVING TUBE SUBSTITUTION GUIDE

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1D5 | 1A4 | E | Change socket to four prong and rewire as follows: |
| | 1B4 | E | |
| | 32 | E | |
| | 34 | E | |
| | 951 | E | |

| No. 2 on octal | to No. | 1 on four prong |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 3 |
| 7 | to | 4 |
| cap | to | cap |

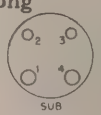



| | | | |
|---|---|---|---|
| | 1E5 | G | No changes. |
| 1D7 | 1A6 | G | Reverse 1A6 to 1C7 procedure. |
| | 1C6 | E | Reverse 1A6 to 1C7 procedure. Parallel circuits only. |
| | 1C7 | E | Parallel circuits only. No changes. |
| 1D8 | 1B8 | E | No changes. |
| 1E4 | 1G4 | G | No changes. |
| | 1H4 | P | |
| | 1LE3 | G | Change socket to loctal and rewire as follows: |

| No. 2 on octal | to No. | 1 on loctal |
|---|---|---|
| 3 | to | 2 |
| 5 | to | 6 |
| 7 | to | 8 |

| | | | |
|---|---|---|---|
| | 30 | P | Change socket to four prong and rewire as follows: |

| No. 2 on octal | to No. | 1 on four prong |
|---|---|---|
| 3 | to | 2 |
| 5 | to | 3 |
| 7 | to | 4 |




| | | | |
|---|---|---|---|
| 1E5 | 1D5 | G | No changes. |
| | 1A4 | P | Change socket to four prong and rewire as follows: |
| | 1B4 | P | |
| | 32 | P | |
| | 34 | P | |
| | 951 | P | |

| No. 2 on octal | to No. | 1 on four prong |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 3 |
| cap | to | cap |
| 7 | to | 4 |

| | | | |
|---|---|---|---|
| 1E7 | | | No practical substitute. |
| 1E8 | 1C8 | E | No changes. |
| 1F4 | 1F5 | E | Change socket to octal and rewire as follows: |

| No. 1 on five prong | to No. | 2 on octal |
|---|---|---|
| 2 | to | 3 |
| 4 | to | 4 |
| 3 | to | 5 |
| 5 | to | 7 |

| | | | |
|---|---|---|---|
| 1F5 | 1F4 | E | Reverse 1F4 to 1F5 procedure. |
| 1F6 | 1F7 | E | Change socket to octal and rewire as follows: |

| No. 1 on six prong | to No. | 2 on octal |
|---|---|---|
| 2 | to | 3 |
| 3 | to | 6 |
| 4 | to | 4 |
| 5 | to | 5 |
| 6 | to | 7 |
| cap | to | cap |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1F7 | 1F6 | E | Reverse 1F6 to 1F7 procedure. |
| 1G4 | 1C3 | G | Reverse 1C3 to 1G4 procedure. |
| | 1E4 | G | No changes. |
| | 1H4 | P | |
| | 1LE3 | G | Same as 1E4 to 1LE3. |
| | 30 | P | Same as 1E4 to 30. |
| 1G5 | 1J5 | G | No changes. |
| 1G6 | 1J6 | P | Parallel circuits only. No changes. |
| 1H4 | 1E4 | P | No changes. |
| | 1LE3 | P | Same as 1E4 to 1LE3. |
| | 30 | P | Same as 1E4 to 30. |
| 1H5 | 1H6 | P | Connect grid cap to socket terminal No. 6. Connect Nos. 4 and 5 together. |
| | 1LD5 | G | Change socket to loctal and rewire as follows: |

| | |
|---|---|
| No. 2 on octal | to No. 1 on loctal |
| 3 | to 2 and 3 |
| 5 | to 4 |
| 7 | to 8 |
| cap | to 6 |

| | | | |
|---|---|---|---|
| | 1LH4 | E | Change socket to loctal and rewire as follows: |

| | |
|---|---|
| No. 2 on octal | to No. 1 on loctal |
| 3 | to 2 |
| 5 | to 4 |
| 7 | to 8 |
| cap | to 6 |

| | | | |
|---|---|---|---|
| | 1S5 | G | Change socket to miniature or make adaptor wiring as follows: |

| | |
|---|---|
| No. 2 on octal | to No. 1 on miniature |
| 3 | to 4 and 5 |
| 5 | to 3 |
| 7 | to 7 |
| cap | to 6 |

| | | | |
|---|---|---|---|
| 1H6 | 1B5 | E | Change socket to six prong and rewire as follows: |

| | |
|---|---|
| No. 2 on octal | to No. 1 on six prong |
| 3 | to 2 |
| 4 | to 3 |
| 5 | to 4 |
| 6 | to 5 |
| 7 | to 6 |

| | | | |
|---|---|---|---|
| 1J5 | 1G5 | G | No changes. |
| 1J6 | 19 | E | Reverse 19 to 1J6 procedure. |
| 1L4 | 1AF4 | G | Parallel circuits only. No changes. |
| | 1SA6 | G | Same as 1T4 to 1SA6. |
| | 1T4 | G | No changes. |
| | 1U4 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1L6 | 1U6 | E | Parallel circuits only. No changes. |
| 1LA4 | 1A5 | G | Same as 1LB4 to 1A5. |
| | 1C5 | G | Same as 1LB4 to 1A5. Parallel circuits only. |
| | 1LB4 | G | No changes. |
| | 1Q5 | G | Same as 1LB4 to 1A5. Parallel circuits only. |
| | 1S4 | G | Same as 1LA4 to 3Q4. Parallel circuits only. |
| | 1T5 | G | Same as 1LB4 to 1A5. |
| | 1W4 | G | Same as 1LB4 to 1W4. |
| | 3Q4 | P | Electric operation only. Change socket to miniature and rewire as follows: |
| | 3S4 | P | |

| No. 1 on loctal | to No. | 1 on miniature. |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 4 |
| 6 | to | 3 |
| 8 | to | 7 |

| | | | |
|---|---|---|---|
| | 3Q5 | P | Same as 1LB4 to 1A5. Series circuits only. |
| 1LA6 | 1A7 | E | Change socket to octal and rewire as follows: |

| No. 1 on loctal | to No. | 2 on octal |
|---|---|---|
| 2 | to | 3 |
| 3 | to | 6 |
| 4 | to | 5 |
| 5 | to | 4 |
| 6 | to | cap |
| 8 | to | 7 |

| | | | |
|---|---|---|---|
| | 1B7 | E | Same as 1LA6 to 1A7. Parallel circuits only. |
| | 1L6 | E | Same as 1LA6 to 1U6. |
| | 1LB6 | P | Rewire as follows: |

No. 5 to No. 7
Connect pins No. 5 and No. 8 together.

| | | | |
|---|---|---|---|
| | 1LC6 | E | No changes. |
| | 1R5 | G | Make adaptor as follows: Break the glass envelope on a burned out loctal tube leaving the extension of the pins intact. Bend the extension of the pins so that they connect to a miniature socket according to the following: |

| No. 1 on miniature | to No. | 1 on loctal |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 3 |
| 4 | to | 4 |
| 6 | to | 6 |
| 7 | to | 8 |

In case this substitution squeals on the high frequency end of the dial, change the oscillator grid resistor to 100M ohms or less if necessary.

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1LA6 | 1U6 | G | Parallel circuits only. Change socket to miniature and rewire as follows: |

| No. 1 on loctal | to No. 1 on miniature |
|---|---|
| 2 | to 2 |
| 3 | to 3 |
| 4 | to 4 |
| 5 | to 5 |
| 6 | to 6 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| 1LB4 | 1A5 | G | Change socket to octal and rewire as follows: |
| | 1T5 | G | |

| No. 1 on loctal | to No. 2 on octal |
|---|---|
| 2 | to 3 |
| 3 | to 4 |
| 6 | to 5 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| | 1C5 | G | Same as 1LB4 to 1A5. Parallel circuits only. |
| | 1LA4 | G | No changes. |
| | 1Q5 | G | Same as 1LB4 to 1A5. Parallel circuits only. |
| | 1S4 | G | Same as 1LA4 to 3Q4. Parallel circuits only. |
| | 1W4 | G | Change socket to miniature and rewire as follows: |

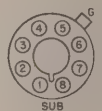
| No. 1 on loctal | to No. 1 on miniature |
|---|---|
| 2 | to 2 |
| 3 | to 3 |
| 6 | to 6 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| | 3Q4 | P | Same as 1LA4 to 3Q4. Electric operation only. |
| | 3Q5 | P | Same as 1LB4 to 1A5. Series circuits only. |
| | 3S4 | P | Same as 1LA4 to 3Q4. Electric operation only. |
| 1LB6 | 1LA6 | P | Rewire as follows: |
| | 1LC6 | P | |

No. 5 to No. 8
7 to 5

| | | | |
|---|---|---|---|
| 1LC5 | 1L4 | G | Same as 1LG5 to 1L4. |
| | 1LG5 | G | No changes. |
| | 1LN5 | G | No changes. |
| | 1N5 | G | Same as 1LN5 to 1N5. |
| | 1P5 | G | |
| | 1S4 | G | Parallel circuits only. Change socket to miniature and rewire as follows: |

| No. 1 on loctal | to No. 1 on miniature |
|---|---|
| 2 | to 2 |
| 3 | to 4 |
| 4 | to 1 |
| 6 | to 3 |
| 8 | to 7 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1LC5 | 1SA6 | G | Change socket to octal and rewire as follows:<br>No. 1 on loctal to No. 2 on octal<br>2 to 8<br>3 to 6<br>4 to 3<br>6 to 4<br>8 to 7<br> <br> |
| | 1T4 | G | Same as 1LG5 to 1L4. |
| | 1U4 | G | Same as 1LG5 to 1L4. |
| 1LC6 | 1A7 | G | Change socket to octal and rewire as follows:<br>No. 1 on loctal to No. 2 on octal<br>2 to 3<br>3 to 6<br>4 to 5<br>5 to 4<br>8 to 7<br>6 to cap<br> <br>  |
| | 1B7 | G | Reverse 1A7 to 1LA6 procedure. Parallel circuits only. |
| | 1L6 | G | Same as 1LA6 to 1U6. |
| | 1LA6 | E | No changes. |
| | 1LB6 | P | Same as 1LA6 to 1LB6. |
| | 1R5 | G | Same as 1LA6 to 1R5. |
| | 1U6 | G | Same as 1LA6 to 1U6. Parallel circuits only. |
| 1LD5 | 1AF5 | P | Parallel circuits only. Reverse 1AF5 to 1LD5 procedure. |
| | 1N6 | G | Change socket to octal and rewire as follows:<br>No. 1 on loctal to No. 2 on octal<br>2 to 3<br>3 to 4<br>4 to 6<br>6 to 5<br>8 to 7<br> <br> |
| | 1S5 | G | Change socket to miniature and rewire as follows:<br>No. 1 on loctal to No. 1 on miniature<br>2 to 5<br>3 to 4<br>4 to 3<br>6 to 6<br>8 to 7<br> <br> |
| | 1SB6 | G | Change socket to octal and rewire as follows:<br>No. 1 on loctal to No. 2 on octal<br>2 to 3<br>3 to 4<br>4 to 5<br>6 to 8<br>8 to 7<br> <br> |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1LD5 | 1U5 | G | Change socket to miniature and rewire as follows: |

| No. 1 on loctal | to No. 1 on miniature |
|---|---|
| 2 | to 2 |
| 3 | to 3 |
| 4 | to 4 |
| 6 | to 6 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| 1LE3 | 1C3 | G | Reverse 1C3 to 1LE3 procedure. |
| | 1E4 | G | Reverse 1E4 to 1LE3 procedure. Not a good oscillator. |
| | 1G4 | G | Change socket to octal and rewire as follows: |

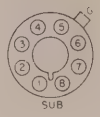
| No. 1 on loctal | to No. 2 on octal |
|---|---|
| 2 | to 3 |
| 6 | to 5 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| | 1H4 | P | Reverse 1E4 to 1LE3 procedure. Not a good oscillator. |
| | 1293 | G | Parallel circuits only. No changes. |
| 1LG5 | 1L4 | G | Change socket to miniature and rewire as follows: |
| | 1T4 | G | |
| | 1U4 | G | |

| No. 1 on loctal | to No. 1 on miniature |
|---|---|
| 2 | to 2 |
| 3 | to 3 |
| 4 | to 5 |
| 6 | to 6 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| | 1LC5 | G | No changes. |
| 1LH4 | 1H5 | E | Change socket to octal and rewire as follows: |

| No. 1 on loctal | to No. 2 on octal |
|---|---|
| 2 | to 3 |
| 4 | to 5 |
| 8 | to 7 |
| 6 | to cap |




| | | | |
|---|---|---|---|
| | 1S5 | G | Make adaptor as follows: |

| No. 1 on base | to No. 1 on top |
|---|---|
| 2 | to 5 and 4 |
| 4 | to 3 |
| 6 | to 6 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| 1LN5 | 1LC5 | E | No changes. |
| | 1N5 | E | Change socket to octal and rewire as follows: |
| | 1P5 | G | |

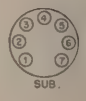
| No. 1 on loctal | to No. 2 on octal |
|---|---|
| 2 | to 3 |
| 3 | to 4 |
| 8 | to 7 |
| 6 | to cap |
| 4 | to 2 |

| | | | |
|---|---|---|---|
| | 1S4 | G | Same as 1LC5 to 1S4. Parallel circuits only. |

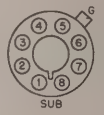
| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1LN5 | 1S5 | P | Change socket to miniature and rewire as follows:<br>Nos. 1 on loctal to No. 1 on miniature<br>2 to 5<br>3 to 4<br>4 to 1<br>6 to 6<br>8 and 5 to 7<br> <br> |
| | 1SA6 | G | Same as 1LC5 to 1SA6. |
| | 3A8 | P | Electric operation only. Same as 1LN5 to 1N5. **Connect pins 5 and 6 to 1** |
| 1N5 | 1D5 | P | No changes. 1D5 rated 60 mils on 2 volts and pulls less than 50 on 1.4 volt. |
| | 1LN5 | E | Change socket to loctal and rewire as follows: |
| | 1LC5 | G | |
| | 1LG5 | " | No. 2 on octal to No. 1 on loctal<br>3 to 2<br>4 to 3<br>7 to 8<br>cap to 6<br>Short loctal terminals 4 and 5<br> <br> |
| | 1P5 | G | No changes. |
| | 1S4 | P | Parallel circuits only. Change socket to miniature and rewire as follows:<br>No. 2 on octal to No. 1 on miniature<br>3 to 2<br>4 to 4<br>7 to 7<br>cap to 3<br> <br> |
| | 1S5 | G | Change socket to miniature and rewire as follows:<br>No. 2 on octal to No. 1 on miniature<br>3 to 5<br>4 to 4<br>7 to 7<br>cap to 6<br> <br> |
| | 1SA6 | G | Make adaptor as follows:<br>No. 2 on base to No. 2 on top<br>3 to 8<br>4 to 6<br>7 to 7 and 3<br>cap to 4 |
| | 1T4 | G | Change socket to miniature or make adaptor as follows: |
| | 1L4 | " | |
| | 1U4 | " | No. 2 on octal to No. 7 on miniature.<br>3 to 2<br>4 to 3<br>7 to 1<br>cap to 6<br>This substitution squeals in some cases, works best as r-f tube.<br> <br> |
| | 3A8 | P | Electric operation only. Remove and tape up wire if any anchored on Nos. 5, 6 and 8. |
| 1N6 | 1LD5 | G | Reverse 1LD5 to 1N6 procedure. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1N6 | 1SB6 | G | Rewire as follows:<br>No. 5 to No. 8<br>6 to 5 |
| 1P5 | 1N5 | G | No changes. |
| | 1S4 | P | Parallel circuits only. Same as 1N5 to 1S4. |
| | 1SA6 | G | Same as 1N5 to 1SA6. |
| | 1T4 | G | Same as 1N5 to 1T4. |
| 1Q5 | 1A5 | G | Parallel circuits only. No changes. |
| | 1C5 | P | No changes. Bias different but tone reasonably good. |
| | 3B5 | P | Move No. 7 to No. 8 and short No. 2 and 7 together. |
| | 3C5 | P | |
| | 3Q4 | P | Same as 1C5 to 3Q4. |
| | 3Q5 | P | Move No. 7 to No. 8 and short No. 2 and 7 together. |
| | 3S4 | P | Same as 1C5 to 3Q4. |
| 1Q6 | 1S6 | E | Rewire as follows:<br>No. 1 to No. 4<br>7 to 1<br>2 to 3 |
| | 1T6 | E | |
| 1R4/1294 | 1A3 | P | Reverse 1A3 to 1R4/1294 procedure. |
| 1R5 | 1A7 | G | Where extra space permits. Reverse 1A7 to 1R5 procedure. |
| | 1LA6 | G | Where space permits. Reverse 1LA6 to 1R5 procedure. |
| | 1LC6 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1S4 | 3E5 | G | Parallel circuits only. Rewire as follows:<br>No. 6 to No. 2<br>3 to 6<br>4 to 3<br>5 to 1<br>7 to 5<br>Connect 1 and 7 together. |
| 1S5 | 1AF5 | E | Parallel circuits only. No changes. |
| | 1LD5 | G | Where space permits. Reverse 1LD5 to 1S5 procedure. |
| | 1SB6 | G | Where space permits. Reverse 1SB6 to 1S5 procedure. |
| | 1U5 | E | Rewire as follows:<br>No. 5 to No. 2<br>Reverse 3 and 4 |
| 1S6 | 1Q6 | E | Rewire as follows:<br>No. 3 to No. 2<br>1 to 7 |
| | 1T6 | E | No changes. |
| 1SA6 | 1L4 | G | Reverse 1T4 to 1SA6 procedure |
| | 1LC5<br>1LN5 | G<br>G | Reverse 1LC5 to 1SA6 procedure. |
| | 1N5 | G | Reverse 1N5 to 1SA6 procedure. |
| | 1T4<br>1U4 | G | Reverse 1T4 to 1SA6 procedure. |
| 1SB6 | 1H5 | G | Extend wire from No. 8 to cap. |
| | 1LD5 | G | Reverse 1LD5 to 1SB6 procedure. |
| | 1S5 | G | Change socket to miniature and rewire as follows:<br>No. 2 on octal to No. 1 on miniature<br>3 to 5<br>4 to 4<br>5 to 3<br>7 to 7<br>8 to 6 |
| 1T4 | 1AF4 | G | Parallel circuits only. No changes. |
| | 1L4 | G | No changes. |
| | 1SA6 | E | Where space permits. Change socket to octal and rewire as follows:<br>No. 1 on miniature to No. 2 on octal<br>2 to 8<br>3 to 6<br>6 to 4<br>7 to 7<br>Connect Nos. 2 and 3 together. |



| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1T4 | 1U4 | G | No changes. |
| 1T5 | 1A5 | G | No changes. 1T5 pulls 10 mils more but it works OK. |
| | 1C5 | G | Parallel circuits only. No changes. |
| | 1D8 | P | Remove and tape up wires if any anchored on No. 6 and 8. Parallel circuits only. |
| | 1G4 | P | No changes. Emergency works good in most cases. |
| | 1LA4 | P | Same as 1A5 to 1LA4 |
| | 1LB4 | P | |
| | 1Q5 | G | Parallel circuits only. No changes. |
| | 1S4 | G | Same as 3Q5 to 3S4 parallel circuits only except omit connection No. 8 on octal to No. 5 on miniature. |
| | 3Q4 | P | Electric operation only. Same as 3Q5 to 3S4 but connect nothing to No. 5 |
| | 3S4 | P | on miniature. |
| 1T6 | 1Q6 | E | Rewire as follows:<br>No. 3 to No. 2<br>1 to 7 |
| | 1S6 | E | No changes. |
| 1U4 | 1AF4 | G | Parallel circuits only. No changes. |
| | 1L4 | G | No changes. |
| | 1S5 | G | Rewire as follows:<br>No. 5 to No. 1<br>2 to 5<br>3 to 4 |
| | 1SA6 | G | Where space permits. Same as 1T4 to 1SA6. |
| | 1T4 | G | No changes. |
| 1U5 | 1S5 | E | Rewire as follows:<br>No. 2 to No. 5<br>Reverse 3 and 4 |
| 1U6 | 1L6 | E | Parallel circuits only. No changes. |
| 1V | 6Z3 | E | No changes. |
| | 12Z3 | G | No changes necessary. Series circuits only. Six volts added to the filament string makes no difference. |
| 1V2 | | | No practical substitute. |
| 1V5 | 1AC5 | E | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1W4 | 1LA4 | G | Where space permits. Reverse 1LB4 to 1W4 procedure. |
| | 1LB4 | G | |
| | 3E5 | G | Rewire as follows:<br>No. 7 to No. 5<br>Connect 1 and 7 together |
| 1W5 | 1V5 | P | No changes. |
| 1X2 | 1B3 | G | Where space permits. Change socket to octal and rewire as follows:<br> <br>Nos. 1,3,4,6 on miniature to No. 2 on octal<br>2,5,7 to 7<br>cap to cap<br> |
| 1Z2 | 1B3 | G | Where space permits. Change socket to octal and rewire as follows:<br> <br>Nos. 1,3,4,6 on miniature to No. 2 on octal<br>2,7,5 to 7<br>cap to cap<br>  |
| 2A3 | 45 | G | No changes. |
| 2A4G | | | No practical substitute. |
| 2A5 | 47 | G | Reverse 47 to 2A5 procedure. |
| | 59 | G | Change socket to seven prong and rewire as follows:<br> <br>No. 1 on six prong to No. 1 on seven prong<br>2 to 2<br>3 to 3<br>4 to 4<br>5 to 6<br>6 to 7<br> <br>Short Nos. 5 and 6 together. |
| | 1619 | G | Parallel circuits only. Make adaptor as follows:<br>No. 1 on base to No. 2 on top<br>2 to 3<br>3 to 4<br>4 to 5<br>5 to 8<br>6 to 7<br>There are or will be many used 1619 tubes available. |
| 2A6 | 2B7 | P | Change socket to seven prong and rewire as follows:<br> <br>No. 1 on six prong to No. 1 on seven prong<br>2 to 2 and 3<br>3 to 4<br>4 to 5<br>5 to 6<br>6 to 7<br>cap to cap<br> |
| | 55 | E | Parallel circuits only. No changes. |
| 2A7 | 2A7S | E | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 2B7S | 2B7 | E | No changes. |
| 2B25 | | | No practical substitute. |
| 2C4 | | | No practical substitute. |
| 2C21 | 6SN7 | G | Change socket to octal and rewire as follows: |

| No. 1 on seven prong | to No. 8 on octal |
|---|---|
| 2 | to 3 |
| 3 | to 2 |
| 4 | to 4 |
| 5 | to 5 |
| 6 | to 6 |
| 7 | to 7 |
| cap | to 1 |

| | | | |
|---|---|---|---|
| 2C22 | 6AD5 | P | Rewire as follows: |
| | 6AF5 | P | Connect grid cap to No. 5 |
| | 6C5 | P | Connect plate cap to No. 3 |
| | 6J5 | P | |
| | 6P5 | P | |
| 2C51 | 7F8 | G | Where space permits. Change socket to loctal and rewire as follows: |

| No. 1 on noval | to No. 2 on loctal |
|---|---|
| 2 | to 4 |
| 3 | to 1 |
| 4 | to 3 |
| 6 | to 6 |
| 7 | to 8 |
| 8 | to 5 |
| 9 | to 7 |

| | | | |
|---|---|---|---|
| | 5670 | G | Parallel circuits only. No changes. |
| 2C52 | 12SN7 | P | No changes. |
| | 12SX7 | P | |
| 2D21 | | | No practical substitute. |
| 2E5 | 2G5 | E | No changes. |
| 2E26 | | | No practical substitute. |
| 2E30 | 5812 | G | No changes. |
| 2E31 | 2E32 | E | No changes. |
| 2E32 | 2E31 | E | No changes. |
| 2E35 | 2E36 | E | No changes. |
| 2E36 | 2E35 | E | No changes. |
| 2E41 | 2E42 | E | No changes. |
| 2E42 | 2E41 | E | No changes. |
| 2G5 | 2E5 | E | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 2G21 | 2G22 | E | No changes. |
| 2G22 | 2G21 | E | No changes. |
| 2S/4S | | | No practical substitute. |
| 2V3 | 2X2/879 | P | Parallel circuits only. Change socket to four prong and rewire as follows: |

| | | |
|---|---|---|
| No. 2 on octal | to No. | 1 on four prong |
| cap | to | cap |
| 7 | to | 4 |

| | | | |
|---|---|---|---|
| 2W3 | 2Z2/G84 | E | Reverse 2Z2/G84 to 2W3 procedure. |
| | 82 | P | Change socket to four prong and rewire as follows: |

| | | |
|---|---|---|
| No. 2 on octal | to No. | 1 on four prong |
| 4 | to | 2 and 3 |
| 8 | to | 4 |

| | | | |
|---|---|---|---|
| 2X2/879 | 2V3 | P | Reverse 2V3 to 2X2/879 procedure. Examine power transformer and determine whether it will handle additional filament current. |
| 2Y2 | | | No practical substitute. |
| 2Z2/G84 | 2W3 | E | Change socket to octal and rewire as follows: |

| | | |
|---|---|---|
| No. 1 on four prong | to No. | 2 on octal |
| 2 | to | 4 |
| 4 | to | 8 |

| | | | |
|---|---|---|---|
| 3A4 | 3Q4 | P | Parallel circuits only. Rewire as follows: |
| | 3S4 | P | Reverse connections on terminals 3 and 4. |
| | 3V4 | P | Parallel circuits only. Rewire as follows: |

| | |
|---|---|
| No. 6 | to No. 2 |
| 4 | to 6 |

| | | | |
|---|---|---|---|
| 3A5 | 3C6 | P | Parallel circuits only. Change socket to loctal and rewire as follows: |

| | |
|---|---|
| No. 1 on miniature | to No. 1 on loctal |
| 2 | to 3 |
| 3 | to 4 |
| 4 | to 7 |
| 5 | to 5 |
| 6 | to 6 |
| 7 | to 8 |

| | | | |
|---|---|---|---|
| 3A8GT | | | No practical substitute. |
| 3B4 | | | No practical substitute. |
| 3B5 | 3C5 | E | No changes. |
| | 3LE4 | E | Same as 3Q5 to 3LF4. |
| | 3LF4 | E | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 3B5 | 3Q5 | E | No changes. |
| | 3C5 | " | |
| | 3S4 | G | Same as 3Q5 to 3S4. |
| | 3Q4 | " | |
| 3B7 | 1291 | E | No changes. |
| 3B7/1291 | 3A5 | P | Change socket to miniature and rewire as follows: |

| No. 1 on loctal | to No. 1 on miniature |
|---|---|
| 2 | to 2 |
| 3 | to 3 |
| 4 | to 4 |
| 6 | to 5 |
| 7 | to 6 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| | 3C6 | P | Parallel circuits only. Rewire as follows: |

| No. 6 | to No. 5 |
|---|---|
| 7 | to 6 |
| 4 | to 7 |
| 3 | to 4 |
| 2 | to 3 |

| | | | |
|---|---|---|---|
| 3C5 | 3B5 | E | No changes. |
| | 3Q5 | E | |
| | 3LE4 | E | Same as 3Q5 to 3LF4 |
| | 3LF4 | E | |
| 3C6 | 3A5 | P | Parallel circuits only. Reverse 3A5 to 3C6 procedure. |
| | 3B7/1291 | G | Parallel circuits only. Reverse 3B7/1291 to 3C6 procedure. |
| 3D6/1299 | 3LF4 | G | Parallel circuits only. No changes. |
| | 3S4 | G | Parallel circuits only. Change socket to miniature and rewire as follows: |
| | 3Q4 | " | |

| No. 1 on loctal | to No. 1 on miniature |
|---|---|
| 2 | to 2 |
| 3 | to 4 |
| 6 | to 3 |
| 7 | to 5 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| | 3Q5 | E | Parallel circuits only. Reverse 3Q5 to 3LE4 procedure. |
| | 3V4 | G | Parallel circuits only. Change socket to miniature and rewire as follows: |

| No. 1 on loctal | to No. 1 on miniature |
|---|---|
| 2 | to 2 |
| 3 | to 3 |
| 6 | to 6 |
| 7 | to 5 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| 3E5 | 3S4 | G | Parallel circuits only. Rewire as follows: |

| No. 3 | to No. 4 |
|---|---|
| 6 | to 3 |

| | | | |
|---|---|---|---|
| | 3V4 | G | Parallel circuits only. No changes. |
| 3E6 | | | No practical substitute. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 3LE4 | 3LF4 | E | No changes. |
| | 3V4 | G | Same as 3D6/1299 to 3V4. |
| 3LF4 | 3D6/1299 | G | Parallel circuits only. No changes. |
| | 3V4 | G | Same as 3D6/1299 to 3V4. |
| 3Q4 | 3A4 | P | Parallel circuits only. Rewire as follows:<br>Reverse No. 3 and No. 4 |
| | 3D6/1299 | G | Parallel circuits only. Reverse 3D6/1299 to 3Q4 procedure. |
| | 3E5 | G | Parallel circuits only. Rewire as follows:<br>No. 6 to No. 2<br>3 to 6<br>4 to 3 |
| | 3LE4<br>3LF4 | G<br>G | Reverse 3D6/1299 to 3Q4 procedure. |
| | 3S4 | G | No changes. |
| | 3V4 | G | Rewire as follows:<br>No. 6 to No. 2<br>3 to 6<br>4 to 3 |
| 3Q5 | 1A5<br>1G4 | P<br>P | No changes. For electric operation only. Battery operation requires resistor 25 to 30 ohms in one of the A leads. |
| | 1LA4<br>1LB4 | P<br>P | Electric operation only. Same as 1A5 to 1LB4. |
| | 1T4 | P | Same as 1A5 to 1T4. Electric operation only. Emergency substitution. |
| | 1T5 | P | No changes. Electric operation only. |
| | 3B5 | E | No changes. |
| | 3C5 | E | No changes. |
| | 3LF4<br>3LE4 | E<br>E | Change socket to loctal and rewire as follows:<br> <br>No. 2 on octal to No. 1 on loctal<br>3 to 2<br>4 to 3<br>5 to 6<br>7 to 8<br>8 to 7<br> |
| | 3Q4<br>3S4 | G<br>G | Change socket to miniature and rewire as follows:<br> <br>No. 2 on octal to No. 1 on miniature<br>3 to 2<br>4 to 4<br>5 to 3<br>7 to 7<br>8 to 5<br> |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 3Q5 | 3V4 | G | Change socket to miniature and rewire as follows: |

| No. 2 on octal | to No. | 1 on miniature |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | 6 |
| 7 | to | 7 |
| 8 | to | 5 |

| | | | |
|---|---|---|---|
| 3S4 | 3E5 | G | Parallel circuits only. Same as 3Q4 to 3E5. |
| | 3Q4 | G | No changes. |
| | 3V4 | G | Same as 3Q4 to 3V4. |
| 3V4 | 3A4 | P | Parallel circuits only. Reverse 3A4 to 3V4 procedure. |
| | 3E5 | G | Parallel circuits only. No changes. |
| | 3Q4 | G | Reverse 3Q4 to 3V4 procedure. |
| | 3S4 | G | |
| 4A6 | | | No practical substitute. |
| 5A6 | | | No practical substitute. |
| 5AX4 | 5AZ4 | G | No changes. |
| | 5U4 | G | |
| | 5V4 | G | |
| | 5W4 | G | |
| | 5Y3 | G | |
| | 5Z4 | G | |
| 5AZ4 | 5AX4 | G | No changes. |
| | 5U4 | G | |
| | 5V4 | G | |
| | 5W4 | G | |
| | 5Y3 | G | |
| | 5Z4 | G | |
| 5R4GY | 5T4 | G | No changes. Use only where inverse peak voltage does not exceed 450 volts per plate. |
| | 5U4 | G | |
| | 5V4 | P | |
| | 5Y3 | P | |
| | 5Z4 | P | |
| | 5X4 | G | Same as 5T4 to 5Y4 |
| | 5Y4 | P | |
| | 5Z3 | G | Where inverse peak voltage per plate does not exceed 450 volts. Change |
| | 80 | P | socket to four prong and rewire as follows: |
| | 83 | G | |
| | 83V | G | |
| | 1275 | G | |

| No. 2 on octal | to No. | 1 on four prong |
|---|---|---|
| 4 | to | 2 |
| 6 | to | 3 |
| 8 | to | 4 |

| | | | |
|---|---|---|---|
| 5T4 | 5AX4 | G | No changes. |
| | 5AZ4 | G | |
| | 5U4 | G | |
| | 5V4 | G | |
| | 5W4 | G | |
| | 5Y3 | G | |
| | 5Z4 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 5T4 | 5Y4 | G | Make adaptor as follows: |
| | 5X4 | G | No. 1 on base to No. 1 on top<br>2 to 8<br>4 to 3<br>6 to 5<br>8 to 7 |
| 5U4 | 5AX4 | G | No changes. |
| | 5AZ4 | G | |
| | 5T4 | G | |
| | 5V4 | G | |
| | 5W4 | G | |
| | 5Y3 | G | |
| | 5Z4 | G | |
| | 5Y4 | G | Same as 5T4 to 5Y4. |
| | 5Z3 | E | Same as 5R4GY to 5Z3. |
| | 80 | G | |
| | 83 | G | |
| | 83V | G | |
| | 1275 | G | |
| 5V4 | 5AX4 | G | No changes. |
| | 5AZ4 | G | |
| | 5T4 | G | |
| | 5U4 | G | |
| | 5W4 | G | |
| | 5Y3 | G | |
| | 5Z4 | G | |
| | 5Y4 | G | Same as 5T4 to 5Y4. |
| | 5Z3 | G | Same as 5R4GY to 5Z3. |
| | 80 | G | |
| | 83 | G | |
| | 83V | G | |
| | 1275 | G | |
| 5W4 | 5AX4 | G | No changes. |
| | 5AZ4 | G | |
| | 5T4 | G | |
| | 5U4 | G | |
| | 6V4 | G | |
| | 5Y3 | G | |
| | 5Z4 | G | |
| | 5Y4 | G | Same as 5T4 to 5Y4. |
| | 5Z3 | G | Same as 5R4GY to 5Z3. |
| | 80 | G | |
| | 83 | G | |
| | 83V | G | |
| | 1275 | G | |
| 5X3 | 5Z3 | G | No changes. |
| | 80 | G | |
| | 83 | G | |
| | 83V | G | |
| | 1275 | G | |
| 5X4 | 5T4 | G | Rewire as follows: |
| | 5U4 | G | |
| | 5V4 | G | No. 7 to No. 2 |
| | 5Y3 | G | 3 to 4 |
| | 5Z4 | G | 5 to 6 |
| | 5AX4 | G | |
| | 5AZ4 | G | |
| | 5W4 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 5X4 | 5Y4 | G | No changes. |
| | 5Z3 | G | Change octal to four prong socket and rewire as follows: |
| | 80 | P | |
| | 83 | G | |
| | 83V | G | |

| No. | 3 on octal | to No. | 2 on four prong |
|---|---|---|---|
| | 5 | to | 3 |
| | 7 | to | 1 |
| | 8 | to | 4 |

| | | | |
|---|---|---|---|
| 5Y3 | 5AX4 | G | No changes. |
| | 5AZ4 | G | |
| | 5T4 | G | |
| | 5U4 | G | |
| | 5V4 | G | |
| | 5W4 | G | |
| | 5Z4 | G | |
| | 5Y4 | E | Same as 5T4 to 5Y4. |
| | 5X4 | E | |
| | 5Z3 | G | Change socket to four prong and rewire as follows: |
| | 80 | E | |
| | 83 | G | |
| | 83V | G | |

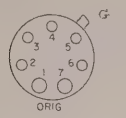
| No. | 2 on octal | to No. | 1 on four prong |
|---|---|---|---|
| | 4 | to | 2 |
| | 6 | to | 3 |
| | 8 | to | 4 |

| | | | |
|---|---|---|---|
| 5Y4 | 5T4 | G | Same as 5X4 to 5T4. |
| | 5U4 | G | |
| | 5V4 | G | |
| | 5W4 | E | |
| | 5Y3 | E | |
| | 5AX4 | F | |
| | 5AZ4 | E | |
| | 5X4 | G | No changes. |
| | 5Z3 | G | Same as 5X4 to 5Z3. |
| | 80 | E | |
| | 83 | G | |
| | 83V | G | |
| 5Z3 | 5AX4 | G | Same as 80 to 5U4. |
| | 5AZ4 | G | |
| | 5T4 | G | |
| | 5U4 | E | |
| | 5V4 | G | |
| | 5W4 | G | |
| | 5Z4 | G | |
| | 5X3 | E | No changes. |
| | 80 | G | |
| | 83 | G | |
| | 83V | G | |
| | 1275 | G | |
| | 5X4 | E | Change four prong to octal socket and rewire as follows: |

| No. | 1 on four prong | to No. | 7 on octal |
|---|---|---|---|
| | 2 | to | 3 |
| | 3 | to | 5 |
| | 4 | to | 8 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 5Z4 | 5AX4 | G | No changes. |
| | 5AZ4 | G | |
| | 5T4 | G | |
| | 5U4 | G | |
| | 5V4 | G | |
| | 5W4 | G | |
| | 5Y3 | G | |
| | 5Y4 | G | Same as 5T4 to 5Y4. |
| | 5X4 | G | |
| 6A3 | 6A5 | E | Same as 6A3 to 6B4. No. 8 is cathode and filament tap. |
| | 6B4 | E | Change socket to octal and rewire as follows:<br> <br>ORIG.<br>No. 1 on four prong to No. 2 on octal<br>2 to 3<br>3 to 5<br>4 to 7<br> <br>SUB |
| 6A4 | 52 | G | No changes. |
| 6A4/LA | 6F6 | G | Parallel circuits only. Change socket to octal and rewire as follows: |
| | 6G6 | G | <br>ORIG.<br>No. 1 on five prong to No. 2 on octal<br>2 to 3<br>3 to 5<br>4 to 4<br>5 to 7 and 8<br> <br>SUB |
| | 6K6 | G | |
| | 6U6 | G | |
| | 6V6 | G | |
| | 41 | G | Parallel circuits only. Change socket to six prong and rewire as follows: |
| | 42 | G | <br>ORIG.<br>No. 1 on five prong to No. 1 on six prong<br>2 to 2<br>3 to 4<br>4 to 3<br>5 to 5 and 6<br> <br>SUB. |
| 6A5 | 6A3 | E | Reverse 6A3 to 6B4 procedure. |
| | 6B4 | E | Connect a 20 ohm resistor from No. 2 to No. 8.<br>Connect a 20 ohm resistor from No. 7 to No. 8. |
| 6A6 | 6E6 | G | Parallel circuits only. No changes. |
| | 6N7 | G | Reverse 6N7 to 6A6 procedure. |
| | 79 | G | Reverse 79 to 6A6 procedure. Parallel circuits only. |
| 6A7 | 6A8 | E | Change socket to octal and rewire as follows: |
| | 6J8 | E | <br>ORIG.<br>No. 1 on seven prong to No. 2 on octal<br>2 to 3<br>3 to 4<br>4 to 6<br>5 to 5<br>6 to 8<br>7 to 7<br>cap to cap<br> <br>SUB |
| | 6K8 | E | |
| | 6D8 | E | Same as 6A7 to 6A8. Parallel circuits only. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6A7 | 7A8 | E | Parallel circuits only. Same as 6A7 to 7B8. |
| | 7B8 | E | Change socket to loctal and rewire as follows: |
| | 7J7 | E | |
| | 7S7 | E | |




| No. 1 on seven prong | to No. | 1 on loctal |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 5 |
| 4 | to | 3 |
| 5 | to | 4 |
| 6 | to | 7 |
| 7 | to | 8 |
| cap | to | " |

| | | | |
|---|---|---|---|
| | 7Q7 | G | Change socket to loctal and rewire as follows: |

| No. 1 on seven prong | to No. | 1 on loctal |
|---|---|---|
| 2 | to | 2 |
| 4 | to | 3 |
| 5 | to | 4 |
| 6 | to | 7 and 5 |
| 7 | to | 8 |
| cap | to | 6 |

Must be well shielded.

| | | | |
|---|---|---|---|
| 6A8 | 6A7 | E | Change socket to seven prong and rewire as follows: |

| No. 2 on octal | to No. | 1 on seven prong |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | 5 |
| 6 | to | 4 |
| 7 | to | 7 |
| 8 | to | 6 |
| cap | to | cap |

| | | | |
|---|---|---|---|
| | 6D8 | E | Parallel circuits only. No changes. |
| | 6J8 | E | No changes. |
| | 6K8 | E | |
| | 7A8 | G | Same as 6D8 to 7A8 but in parallel circuit only. |
| | 7B8 | G | Same as 6D8 to 7A8 |
| | 7J7 | G | Same as 6J8 to 7J7 |
| | 7Q7 | G | Change socket to loctal and rewire as follows: |

| No. 2 on octal | to No. | 1 on loctal |
|---|---|---|
| 3 | to | 2 |
| 5 | to | 4 |
| 6 | to | 3 |
| 7 | to | 8 |
| 8 | to | 7 and 5 |
| cap | to | 6 |

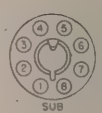
Must be well shielded. Realign if necessary.

| | | | |
|---|---|---|---|
| 6AB4 | 6C4 | G | Remove and tape up any wires anchored on No. 5. |
| | 6J4 | P | Parallel circuits only. Rewire as follows: |

| No. 7 | to No. | 2 |
|---|---|---|
| 1 | to | 7 |

Do not use blank connections on socket.

## RECEIVING TUBE SUBSTITUTION GUIDE

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6AB4 | 6N4 | P | Parallel circuits only. Rewire as follows:<br>Reverse No. 6 and No. 7<br>No. 1 to No. 5<br>Remove and tape any wires connected to unused pins. |
| | 9002 | P | Rewire as follows:<br>Remove and tape up any wires anchored on pins No. 2 and No. 5 |
| 6AB5/6N5 | 6E5 | P | Parallel circuits only. No changes. |
| | 6U5/6G5 | P | Parallel circuits only. No changes. |
| 6AB6 | 6AC6 | G | Parallel circuits only. No changes. |
| | 6B5 | G | Change socket to six prong and rewire as follows, (parallel circuits):<br>No. 2 on octal to No. 1 on six prong<br>3 to 2<br>4 to 3<br>5 to 4<br>7 to 6<br>8 to 5<br> <br><br> <br> |
| | 6N6 | G | No changes. Parallel circuits only. |
| 6AB7/1853 | 6AC7/1852 | G | No changes. |
| | 6AJ7 | G | No changes. |
| | 6SD7 | G | Parallel circuits only. No changes. |
| | 6SE7 | G | |
| | 6SJ7 | G | |
| | 6SK7 | G | |
| | 6SS7 | G | |
| | 5693 | G | |
| | 7V7 | G | Change socket to loctal and rewire as follows:<br>No. 2 on octal to No. 1 on loctal<br>3 to 4<br>4 to 6<br>5 to 7<br>6 to 3<br>7 to 8<br>8 to 2<br> <br><br>  <br> |
| | 7W7 | G | Change socket to loctal and rewire as follows:<br>No. 2 on octal to No. 1 on loctal<br>3 to 5<br>4 to 6<br>5 to 4 or 7<br>6 to 3<br>7 to 8<br>8 to 2<br> <br><br> <br> |
| 6AC5G | 6AC5GT | E | No changes. |
| | 6AC5GT/G | E | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6AC5GT | 6AC5G | E | No changes. |
| | 6AC5GT/G | E | |
| 6AC6 | 6AB6 | G | Parallel circuits only. No changes. |
| 6AC7 | 7W7 | G | Same as 6AB7/1853 to 7W7. |
| 6AC7/1852 | 6AB7/1853 | G | No changes. |
| | 6AH6 | G | Change socket to miniature and rewire as follows: |

| No. 2 on octal | to No. | 3 on miniature |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 1 |
| 5 | to | 7 |
| 6 | to | 6 |
| 7 | to | 4 |
| 8 | to | 5 |

| | | | |
|---|---|---|---|
| | 6AJ7 | G | No changes. |
| | 6SD7 | G | Parallel circuits only. No changes. |
| | 6SE7 | G | |
| | 6SJ7 | G | |
| | 6SK7 | G | |
| | 6SS7 | G | |
| | 5693 | G | |
| | 7V7 | G | Same as 6AB7/1853 to 7V7. |
| 6AD4 | 6K4 | G | No changes. |
| 6AD5 | 6AE5 | G | No changes. |
| | 6AF5 | G | |
| | 6C5 | G | |
| | 6J5 | G | |
| | 6P5 | G | |
| | 6F5 | E | Rewire as follows: |

Remove wires from No. 3 and connect to No. 4. Connect grid lead to No. 5. This pin may be used for anchor. Extend to grid cap.

| | | | |
|---|---|---|---|
| | 6K5 | G | Rewire as follows: |

Connect terminal No. 5 to grid cap. This terminal may be used as an anchor.

| | | | |
|---|---|---|---|
| | 7B4 | G | Change socket to loctal and rewire as follows: |

| No. 2 on octal | to No. | 1 on loctal |
|---|---|---|
| 3 | to | 2 |
| 5 | to | 6 |
| 7 | to | 8 |
| 8 | to | 7 |

| | | | |
|---|---|---|---|
| 6AD6 | 6AF6 | G | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6AD7 | 6F7 | G | Parallel circuits only. Change socket to seven prong and rewire as follows: |

| | |
|---|---|
| No. 1 on octal | to No. 5 on seven prong |
| 2 | to 1 |
| 3 | to 2 |
| 4 | to 3 |
| 5 | to cap |
| 6 | to 4 |
| 7 | to 7 |
| 8 | to 6 |

| | | | |
|---|---|---|---|
| | 6P7 | G | Parallel circuits only. Remove wires from No. 5 and extend to grid cap. Rewire as follows: |

| | |
|---|---|
| No. 4 | to No. 5 |
| 3 | to 4 |
| 7 | to 3 |
| 1 | to 7 |

| | | | |
|---|---|---|---|
| 6AE5 | 6AD5 | | No changes. |
| | 6AF5 | | |
| | 6C5 | | |
| | 6J5 | | |
| | 6P5 | | |
| 6AE6 | 6AH7 | G | Parallel circuits only. Rewire as follows: |

Remove and tape up any wires on No. 1

| | |
|---|---|
| No. 8 | to No. 4 |
| 2 | to 8 |
| 4 | to 6 |

Connect No. 4 and No. 2 together
Connect No. 1 and No. 5 together

| | | | |
|---|---|---|---|
| | 6N7 | P | Parallel circuits only. Rewire as follows: |

No. 4 to No. 6
Connect No. 4 and No. 5 together.

| | | | |
|---|---|---|---|
| 6AF5 | 6AD5 | G | No changes. |
| | 6AE5 | G | |
| | 6C5 | G | |
| | 6J5 | G | |
| | 6P5 | G | |
| 6AF6 | 6AD6 | G | No changes. |
| 6AF7 | | | No practical substitute. |
| 6AG5 | 6AJ5 | P | Parallel circuits only. No changes. |
| | 6AK5 | G | Parallel circuits only. No changes. |
| | 6AU6 | G | Connect pins No 2 and No. 7 together. |
| | 6BC5 | G | No changes. |
| | 5590 | G | Parallel circuits only. No changes. |
| | 5591 | G | |
| | 9001 | G | |
| | 9003 | G | |
| 6AG6G | | | No practical substitute. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6AG7 | 6AK7 | E | No changes. |
| 6AH5 | 6AL6 | G | Rewire as follows:<br>No. 4 to cap<br>1 to 4<br>6 to 5 |
| | 6L6 | G | Rewire as follows:<br>No. 4 to No. 3<br>1 to 4<br>6 to 5 |
| 6AH6 * | 6AJ5 | P | Parallel circuits only. No changes. |
| | 6AK5 | P | |
| | 6AS6 | P | Parallel circuits only. Rewire as follows:<br>Reverse No. 2 and No. 7 |
| | 6AU6 | P | Parallel circuits only. No changes. |
| | 6BC5 | G | Parallel circuits only. No changes. |
| | 6BD6 | P | Parallel circuits only. No changes. |
| | EF50 | P | Parallel circuits only. Reverse EF50 to 6BA6 procedure. |
| 6AH7 | 6AE6 | G | Parallel circuits only. Reverse 6AE6 to 6AH7 procedure. |
| | 6C8 | G | Rewire as follows:<br>Connect wire from No. 1 to grid cap.<br>Remove wires from No. 2<br>No. 8 to No. 2<br>4 to 8<br>Connect wires removed from No. 2 to No. 4. |
| | 6SN7 | P | Parallel circuits only. Rewire as follows:<br>Reverse No. 2 and No. 3<br>Remove wires from No. 4<br>No. 5 to No. 4<br>6 to 5<br>Connect wires removed from No. 4 to No. 6. |
| | 7N7 | P | Parallel circuits only. Change socket to loctal and rewire as follows:<br>No. 1 on octal to No. 4 on loctal<br>2 to 2<br>3 to 3<br>4 to 7<br>5 to 5<br>6 to 6<br>7 to 8<br>8 to 1 |
| 6AJ5 | 6AG5 | P | Parallel circuits only. No changes. |
| | 6AK5 | P | No changes. |
| | 6AU6 | P | Parallel circuits only. No changes. |

* See Addendum at back of this section.

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6AJ7 | 6AB7/1853 | G | No changes. |
| | 6AC7/1852 | G | |
| | 6SD7 | G | Parallel circuits only. No changes. |
| | 6SE7 | G | |
| | 6SJ7 | G | |
| | 6SK7 | G | |
| | 6SS7 | G | |
| | 5693 | G | |
| 6AK5 | 6AG5 | G | Parallel circuits only. No changes. |
| | 6AH6 | G | Parallel circuits only. Connect No. 2 and No. 7 together. |
| | 6AJ5 | P | No changes. |
| | 6AU6 | P | Parallel circuits only. Connect Nos. 2 and 7 together. |
| 6AK6 | 6AR5 | G | Parallel circuits only. Rewire as follows:<br>Connect No. 2 and No. 7 together |
| 6AK7 | 6AG7 | E | No changes. |
| 6AL5 | 6H6 | G | Where space permits. Change socket to octal and rewire as follows:<br>No. 1 on miniature to No. 8 on octal<br>2 to 3<br>3 to 2<br>4 to 7<br>5 to 4<br>7 to 5 |
| 6AL6 | 6AH5 | G | Reverse 6AH5 to 6AL6 procedure. |
| | 6L6 | E | Rewire as follows:<br>cap to No. 3 |
| 6AL7 | | | No practical substitute. |
| 6AM5 | 6AQ5 | P | Parallel circuits only.<br>No. 7 to No. 6 |
| | 6AR5 | P | Parallel circuits only. Rewire as follows:<br>No. 7 to No. 6 |
| 6AM6 | 6AH6 | G | Parallel circuits only. Same as 6AM6 to 6AU6. |
| | 6AK6 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6AM6 | 6AU6 | G | Rewire as follows: |
| | 6BA6 | G | Remove wires from No. 2 |
| | 6BD6 | G | No. 6 to No. 2 |
| | | | 7 to 6 |
| | | | Connect wires removed from No. 2 to No. 7. |
| 6AN5 | 6AQ5 | G | Rewire as follows; |
| | | | No. 7 to No. 2 |
| 6AN6 | | | No practical substitute. |
| 6AN7 | | | No practical substitute. |
| 6AQ5 | 6AM5 | P | Parallel circuits only. Rewire as follows: |
| | | | No. 7 to No. 1 |
| | | | 6 to 7 |
| | 6AN5 | G | Parallel circuits only. Rewire as follows: Parallel circuits only. |
| | | | No. 7 to No. 1 |
| | 6AR5 | G | Rewire as follows: |
| | | | No. 7 to No. 1 |
| | 6AS5 | G | Parallel circuits only. Reverse 6AS5 to 6AQ5 procedure. |
| | 6BF5 | P | Parallel circuits only. No changes. |
| | 6V6 | G | Where space permits. Change socket to octal and rewire as follows: |
| | | | No. 1 on miniature to No. 5 on octal |
| | | | 2 to 8 |
| | | | 3 to 2 |
| | | | 4 to 7 |
| | | | 5 to 3 |
| | | | 6 to 4 |
| | | | 7 to 5 |
| 6AQ6 | 6BD7 | G | Parallel circuits only. Reverse 6BD7 to 6AQ6 procedure. |
| | 6AT6 | G | Parallel circuits only. No changes. |
| | 6AV6 | G | |
| | 6BF6 | G | |
| | 6BK6 | G | |
| | 6BT6 | G | |
| | 6BU6 | G | |
| 6AQ7 | 6AW7 | G | Rewire as follows: |
| | | | Remove wires from No. 1 |
| | | | No. 2 to No. 1 |
| | | | 4 to 2 |
| | | | Connect wires removed from No. 1 to No. 4. |
| | | | Remove wires from No. 3 |
| | | | No. 5 to No. 3 |
| | | | 6 to 5 |
| | | | Connect wires removed from No. 3 to No. 6. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6AR5 | 6AK6 | G | Parallel circuits only. Rewire as follows:<br>Connect No. 2 to No. 7 together. |
| | 6AM5 | P | Parallel circuits only. Rewire as follows:<br>No. 6 to No. 7 |
| | 6AQ5 | G | Parallel circuits only. No changes. Any wires connected to terminal No. 7 must be removed and taped up. |
| | 6AS5 | G | Parallel circuits only. Reverse 6AS5 to 6AR5 procedure. |
| 6AR6 | 6F6 | G | Parallel circuits only. Rewire as follows: |
| | 6G6 | G | No. 8 to No. 2 |
| | 6K6 | G | 1 to 8 |
| | 6L6 | G | 5 to 4 |
| | 6U6 | G | 7 to 5 |
| | 6V6 | G | 6 to 7 |
| | 6W6 | G | |
| | 6Y6 | G | |
| | 5824 | G | |
| 6AR7 | | | No practical substitute. |
| 6AS5 | 6AN5 | G | Parallel circuits only. Rewire as follows:<br>Reverse No. 1 and No. 2<br>5 to 1<br>7 to 5 |
| | 6AQ5 | G | Parallel circuits only. Rewire as follows:<br>Reverse No. 1 and No. 2<br>5 and 7 |
| | 6AR5 | G | Parallel circuits only. Rewire as follows:<br>Reverse No. 1 and No. 2<br>5 to 1<br>7 to 5 |
| 6AS6 | 6AH6 | P | Parallel circuits only. Rewire as follows:<br>Reverse No. 2 and No. 7 |
| | 6BH6 | G | Parallel circuits only. No changes. |
| | 6BJ6 | G | |
| | 6CB6 | G | |
| 6AS7G | | | No practical substitute. |
| 6AT6 | 6AQ6 | G | Parallel circuits only. No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6AT6 | 6AV6 | G | No changes. |
| | 6BF6 | G | |
| | 6BK6 | G | |
| | 6BT6 | G | |
| | 6BU6 | G | |
| | 6BD7 | G | Parallel circuits only. Reverse 6BD7 to 6AQ6 procedure. |
| 6AU5 | 6AV5 | G | Parallel circuits only. No changes. |
| | 6BD5 | G | |
| 6AU6 * | 6AG5 | P | No changes. |
| | 6AJ5 | P | Parallel circuits only. No changes. |
| | 6AK5 | P | |
| | 6AK6 | P | |
| | 6BA6 | G | No changes. |
| | 6BD6 | G | |
| | 6BH6 | G | Parallel circuits only. Rewire as follows: |
| | 6AS6 | G | Reverse No. 2 and No. 7 1683 Johns... |
| | EF50 | G | Reverse EF50 to 6BA6 procedure. |
| 6AV5 | 6AU5 | G | No changes. |
| | 6BD5 | G | |
| | 6BQ6 | G | Parallel circuits only. Reverse 6BQ6 to 6BD5 procedure. |
| 6AV6 | 6AQ6 | G | Parallel circuits only. No changes. |
| | 6AT6 | G | No changes. |
| 6AW7 | 6AQ7 | G | Reverse 6AQ7 to 6AW7 procedure. |
| 6AX5 | 6AX6 | E | Parallel circuits only. Tie Nos. 4 and 8 together. |
| | 6BY5 | E | Parallel circuits only. Rewire as follows: Connect Nos. 1 and 8 together; also Nos. 3 and 4. |
| | 6W5 | G | Parallel circuits only. No changes. |
| | 6X5 | G | |
| | 6ZY5 | G | |
| | 1274 | G | |
| 6AX6 | 6AX5 | G | Can be used only where No. 4 and No. 8 in 6AX6 are connected together without change. |
| | 6W5 | G | |
| | 6X5 | G | |
| | 6ZY5 | G | |
| | 1274 | G | |



* See Addendum at back of this section.

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6AX6 | 6BY5 | E | Parallel circuits only. Rewire as follows:<br>No. 4 to No. 1<br>3 to 4 |
| 6B4 | 6A3 | G | Reverse 6A3 to 6B4 procedure. |
| | 6A5 | E | No changes but remove any wires anchored on No. 8. |
| 6B5 | 6AB6 | E | Same as 6B5 to 6N6. Parallel circuits only. |
| | 6N6 | E | Change socket to octal and rewire as follows:<br>No. 1 on six prong to No. 2 on octal<br>2 to 3<br>3 to 4<br>4 to 5<br>5 to 8<br>6 to 7 |
| | 42 | P | No changes. |
| 6B6 | 6Q7 | E | No changes. |
| | 6SQ7 | E | Make adaptor as follows:<br>No. 1 on base to No. 1 on top<br>2 to 8<br>3 to 6<br>4 to 4<br>5 to 5<br>7 to 7<br>8 to 3<br>Extend No. 2 on top to grid connection. |
| | 6T7 | E | Parallel circuits only. No changes. |
| | 7B6 | G | Change socket to loctal and rewire as follows:<br>No. 2 on octal to No. 1 on loctal<br>3 to 2<br>4 to 5<br>5 to 6<br>7 to 8<br>8 to 4 or 7<br>cap to 3 |
| | 7C6 | E | Same as 6B6 to 7B6. Parallel circuits only. |
| | 75 | E | Change socket to six prong and rewire as follows:<br>No. 2 on octal to No. 1 on six prong<br>3 to 2<br>4 to 3<br>5 to 4<br>7 to 6<br>8 to 5<br>cap to cap |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6B7 | 6B8 | E | Change socket to octal and rewire as follows: |

| No. 1 on seven prong | to No. | 2 on octal |
|---|---|---|
| 2 | to | 3 |
| 3 | to | 6 |
| 4 | to | 4 |
| 5 | to | 5 |
| 6 | to | 8 |
| 7 | to | 7 |
| cap | to | cap |

| | 7E7 | G | Change socket to loctal and rewire as follows: |
|---|---|---|---|

| No. 1 on seven prong | to No. | 1 on loctal |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 5 |
| 4 | to | 3 |
| 5 | to | 4 |
| 6 | to | 7 |
| 7 | to | 8 |
| cap | to | 6 |

| 6B8 | 6B7 | E | Reverse 6B7 to 6B8 procedure. |
|---|---|---|---|
| | 7E7 | G | Change socket to loctal and rewire as follows: |

| No. 2 on octal | to No. | 1 on loctal |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | 4 |
| 6 | to | 5 |
| 7 | to | 8 |
| 8 | to | 7 |
| cap | to | 6 |

| 6BA5 | 6BH6 | P | Change to miniature and connect as follows: |
|---|---|---|---|
| | 6BJ6 | P | |

The 6BA5 base numbers 1 to 6 clockwise; an arrow indicates plate lead No. 1.

| No. 1 on 6BA5 base | to No. | 5 on miniature |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 1 |
| 4 | to | 3 and 7 |
| 5 | to | 6 |
| 6 | to | 4 |

| 6BA6 | 6AU6 | G | No changes. |
|---|---|---|---|
| | 6BD6 | G | |
| | EF50 | G | Reverse EF50 to 6BA6 procedure. |
| 6BA7 | 6BE6 | G | Change socket to miniature and rewire as follows: |

| No. 1 on noval | to No. | 6 on miniature |
|---|---|---|
| 2 | to | 1 |
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | 4 |
| 6 | to | 2 |
| 7 | to | 7 |
| 9 | to | 5 |

| 6BC5 | 6AG5 | P | No changes. |
|---|---|---|---|
| | 6AJ5 | P | Parallel circuits only. No changes. |
| | 6AK5 | P | |
| | 9001 | P | |
| | 9003 | P | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6BC7 | | | No practical substitute. |
| 6BD5 | 6AU5 | P | Parallel circuits only. No changes. |
| | 6AV5 | P | |
| | 6BQ6 | G | Parallel circuits only. Reverse 6BQ6 to 6BD5 procedure. |
| 6BD6 | 6AH6 | P | Parallel circuits only. No changes. |
| | EF50 | G | Reverse EF50 to 6BA6 procedure. |
| 6BD7 | 6AQ6 | G | Parallel circuits only. Change socket to miniature and rewire as follows: |
| | 6AT6 | G | |
| | 6BF6 | G | |
| | 6BT6 | G | |
| | 6BU6 | G | |

| No. | | No. |
|---|---|---|
| 1 on noval | to | 7 on miniature |
| 2 | to | 1 |
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | 4 |
| 6 | to | 5 |
| 8 | to | 6 |

| | | | |
|---|---|---|---|
| 6BE6 | 6BA7 | G | Change socket to nine pin noval and rewire as follows: |

| No. | | No. |
|---|---|---|
| 1 on miniature | to | 2 on noval |
| 2 | to | 3 |
| 3 | to | 4 |
| 4 | to | 5 |
| 5 | to | 9 |
| 6 | to | 1 |
| 7 | to | 7 |

| | | | |
|---|---|---|---|
| | 5915 | G | No changes. |
| 6BF5 | 6AQ5 | P | Parallel circuits only. No changes. |
| | 6AR5 | P | Parallel circuits only. Short No. 7 to No. 1. |
| 6BF6 | 6BD7 | G | Parallel circuits only. Reverse 6BD7 to 6AQ6 procedure. |
| | 6BU6 | G | No changes. |
| 6BF7 | 6BG7 | E | |
| 6BG6 | 6BQ6 | P | Parallel circuits only. Rewire as follows: |

| | | |
|---|---|---|
| No. 8 | to No. | 4 |
| 3 | to | 8 |

| | | | |
|---|---|---|---|
| | 6CD6 | P | Parallel circuits only. No changes. Sometimes it is necessary to increase wattage rating of screen resistor. |
| 6BG7 | 6BF7 | E | No changes. |
| 6BH6 | 6BJ6 | G | No changes. |
| | 6AS6 | G | Parallel circuits only. No changes. |
| | 6BC5 | P | |
| | 6CB6 | G | |
| 6BJ6 | 6AS6 | G | Parallel circuits only. No changes. |
| | 6BC5 | P | |
| | 6CB6 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6BJ6 | 6BH6 | G | No changes. |
| 6BK6 | 6AT6 | G | No changes. |
| | 6AV6 | G | |
| | 6BF6 | G | |
| | 6BT6 | G | |
| | 6BU6 | G | |
| 6BN6 | | | No practical substitute. |
| 6BQ6 | 6AV5 | G | Parallel circuits only. Rewire as follows: |
| | 6BD5 | G | No. 5 to No. 1 |
| | 6AU5 | G | 8 to 3 |
| | | | cap to 5 |
| | | | 4 to 8 |
| | 6BG6 | P | Parallel circuits only. Rewire as follows: |
| | | | No. 8 to No. 3 |
| | | | 4 to 8 |
| | 6CD6 | P | Where extra filament current is available. Parallel circuits only. Rewire as follows: |
| | | | No. 8 to No. 3 |
| | | | 4 to 8 |
| 6BT6 | 6AQ6 | G | Parallel circuits only. No changes. |
| | 6BD7 | G | Parallel circuits only. Reverse 6BD7 to 6AQ6 procedure. |
| | 6BK6 | G | No changes. |
| 6BU6 | 6BD7 | G | Parallel circuits only. Reverse 6BD7 to 6AQ6 procedure. |
| | 6BF6 | G | No changes. |
| 6BY5 | 6AX5 | G | Parallel circuits only. Where No. 1 and No. 8 are connected together, change connections as follows: |
| | 6W5 | G | |
| | 6X5 | G | |
| | 6ZY5 | G | No. 4 to No. 3 |
| | 1274 | G | |
| 6C4 | 6AB4 | G | Rewire as follows: |
| | | | Connect No. 5 to No. 1 |
| | 6J4 | P | Parallel circuits only. Rewire as follows: |
| | | | No. 7 to No. 2 |
| | | | 1 to 7 |
| | | | 5 to 7 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6C4 | 6AD5 | P | Parallel circuits only. Where space permits, change socket to octal and |
| | 6AE5 | P | rewire as follows: |
| | 6AF5 | P | |
| | 6C5 | P | |
| | 6J5 | P | |
| | 6P5 | P | |

| No. 1 on miniature | to No. | 3 on octal |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 7 |
| 5 | to | 3 |
| 6 | to | 5 |
| 7 | to | 8 |

| | | | |
|---|---|---|---|
| | 6L5 | P | Where space permits. Same as 6C4 to 6AD5. |
| | 6N4 | P | Parallel circuits only. Rewire as follows: |

| No. 1 | to No. | 5 |
|---|---|---|

Reverse No. 6 and No. 7.

| | | | |
|---|---|---|---|
| | 7A4 | G | Parallel circuits only. Where space permits. Change socket to loctal and |
| | 7B4 | P | rewire as follows: |

| No. 1 on miniature | to No. | 2 on loctal |
|---|---|---|
| 3 | to | 1 |
| 4 | to | 8 |
| 5 | to | 2 |
| 6 | to | 6 |
| 7 | to | 7 |

| | | | |
|---|---|---|---|
| | 9002 | P | No changes. |
| 6C5 | 6AD5 | G | No changes. |
| | 6AE5 | G | |
| | 6AF5 | G | |
| | 6C4 | G | Reverse 6C4 to 6AD5 procedure. |
| | 6F5 | G | Make adaptor as follows: |

| No. 1 on base | to No. | 1 on top |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 4 |
| 5 | to | cap |
| 7 | to | 7 |
| 8 | to | 8 |

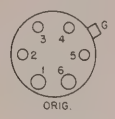
| | | | |
|---|---|---|---|
| | 6J5 | G | No changes. |
| | 6P5 | G | |
| | 7A4 | G | Same as 6J5 to 7A4. |
| | 7B4 | G | Same as 6J5 to 7A4 |
| | 37 | G | Change socket to five prong and rewire as follows: |
| | 76 | G | |

| No. 2 on octal | to No. | 1 on five prong |
|---|---|---|
| 3 | to | 2 |
| 5 | to | 3 |
| 7 | to | 5 |
| 8 | to | 4 |

| | | | |
|---|---|---|---|
| 6C6* | 6D6 | G | No changes. |

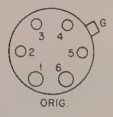
* See Addendum at back of this section.

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6C6 | 6D7 | G | Change socket to seven prong and rewire as follows: |
| | 6E7 | G | |



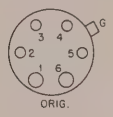

| No. 1 on six prong | to No. | 1 on seven prong |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 3 |
| 4 | to | 4 |
| 5 | to | 6 |
| 6 | to | 7 |
| cap | to | cap |

| | | | |
|---|---|---|---|
| | 6J7 | E | Change socket to octal and rewire as follows: |
| | 6K7 | G | |
| | 6U7 | G | |



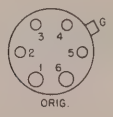

| No. 1 on six prong | to No. | 2 on octal |
|---|---|---|
| 2 | to | 3 |
| 3 | to | 4 |
| 4 | to | 5 |
| 5 | to | 8 |
| 6 | to | 7 |
| cap | to | cap |

| | | | |
|---|---|---|---|
| | 6S7 | G | Same as 6C6 to 6J7. Parallel circuits only. |
| | 6SJ7 | E | Change socket to octal and rewire as follows: |
| | 6SK7 | G | |




| No. 1 on six prong | to No. | 2 on octal |
|---|---|---|
| 2 | to | 8 |
| 3 | to | 6 |
| 4 | to | 3 |
| 5 | to | 5 |
| 6 | to | 7 |
| cap | to | 4 |

| | | | |
|---|---|---|---|
| | 6W7 | G | Same as 6C6 to 6J7. Parallel circuits only. |
| | 7A7 | G | Change socket to loctal and rewire as follows: |




| No. 1 on six prong | to No. | 1 on loctal |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 3 |
| 4 | to | 4 |
| 5 | to | 7 |
| 6 | to | 8 |
| cap | to | 6 |

| | | | |
|---|---|---|---|
| | 7B7 | G | Same as 6C6 to 7A7. Parallel circuits only. |
| | 7C7 | G | |
| | 77 | E | No changes. |
| | 78 | E | |
| | 1221 | E | |
| 6C7 | 6Q7 | G | Make adaptor as follows: |
| | 6R7 | G | |

| No. 1 on base | to No. | 2 on top |
|---|---|---|
| 2 | to | 3 |
| 4 | to | 4 |
| 5 | to | 5 |
| 6 | to | 8 |
| 7 | to | 7 |

| | | | |
|---|---|---|---|
| | 6T7 | G | Same as 6C7 to 6Q7. Parallel circuits only. |
| 6C8 | 6F8 | G | Parallel circuits only. No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6C8 | 7F7 | G | Change socket to loctal and rewire as follows: |

| No. 2 on octal | to No. 1 on loctal |
|---|---|
| 3 | to 3 |
| 4 | to 2 |
| 5 | to 5 |
| 6 | to 6 |
| 7 | to 8 |
| 8 | to 7 |
| cap | to 4 |

| | | | |
|---|---|---|---|
| 6CB6 | 6AS6 | P | Parallel circuits only. No changes. |
| | 6BH6 | P | |
| | 6BJ6 | P | |
| 6CD6 | 6BG6 | G | Parallel circuits only. No changes. |
| | 6BQ6 | P | Parallel circuits only. Rewire as follows: |

| No. 8 | to No. 4 |
|---|---|
| 3 | to 8 |

| | | | |
|---|---|---|---|
| 6D4 | | | No practical substitute. |
| 6D6 | 6C6 | G | No changes. |
| | 6D7 | G | Same as 6C6 to 6D7. |
| | 6E7 | G | Same as 6C6 to 6D7. |
| | 6J7 | G | Same as 6C6 to 6J7. |
| | 6K7 | E | |
| | 6S7 | G | Same as 6C6 to 6J7. Parallel circuits only. |
| | 6SJ7 | G | Same as 6C6 to 6SJ7. |
| | 6SK7 | E | |
| | 6U7 | G | Same as 6C6 to 6J7. |
| | 6W7 | G | Same as 6C6 to 6J7. Parallel circuits only. |
| | 7A7 | E | Same as 6C6 to 7A7. |
| | 7B7 | G | Same as 6C6 to 7A7. Parallel circuits only. |
| | 7C7 | G | |
| | 39/44 | G | Same as 78 to 39/44. |
| | 77 | G | No changes. |
| | 78 | E | |
| 6D7 | 6E7 | G | No changes. |
| 6D8 | 6A7 | G | Parallel circuits only. Reverse 6A7 to 6A8 procedure. |
| | 6A8 | G | Parallel circuits only. No changes. |
| | 6J8 | G | |
| | 6K8 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6D8 | 7A8 | G | Change socket to loctal and rewire as follows: |

| No. 2 on octal | to No. | 1 on loctal |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 5 |
| 5 | to | 4 |
| 6 | to | 3 |
| 7 | to | 8 |
| 8 | to | 7 |
| cap | to | 6 |

| | | | |
|---|---|---|---|
| | 7B8 | G | Same as 6D8 to 7A8. Parallel circuits only. |
| | 7J7 | G | |
| | 7S7 | G | |
| | 7Q7 | G | Same as 6A8 to 7Q7. Parallel circuits only. |
| | 12A8 | P | Series circuits only. No changes. |
| | 12K8 | P | |
| 6E5 | 2E5 | E | Heater voltage - current ratings differ. |
| | 6AB5/6N5 | P | Parallel circuits only. No changes. |
| | 6T5 | E | No changes. |
| | 6U5/6G5 | E | |
| 6E6 | 6A6 | G | Parallel circuits only. No changes. |
| 6E7 | 6D7 | G | No changes. |
| 6E8 | | | No practical substitute. |
| 6F4 | 6L4 | P | No changes. |
| 6F5 | 6AD5 | G | Make adaptor as follows: |

| No. 1 on base | to No. | 1 on socket |
|---|---|---|
| 2 | to | 2 |
| 4 | to | 3 |
| 7 | to | 7 |
| 8 | to | 8 |
| Connect grid cap | to | 5 on base. |

| | | | |
|---|---|---|---|
| | 6C5 | G | Reverse 6C5 to 6F5 procedure. |
| | 6J5 | G | |
| | 6K5 | E | Change connections as follows: |

| No. 4 | to No. 3 |
|---|---|

| | | | |
|---|---|---|---|
| | 6SF5 | E | Make adaptor as follows: |

| No. 1 on base | to No. | 1 on top |
|---|---|---|
| 2 | to | 8 |
| 4 | to | 5 |
| 7 | to | 7 |
| 8 | to | 2 |
| cap | to | 3 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6F5 | 7A4 | G | Change socket to loctal and rewire as follows: |
| | 7B4 | G | |

| | | |
|---|---|---|
| No. 2 on octal | to No. | 1 on loctal |
| 4 | to | 2 |
| 7 | to | 8 |
| 8 | to | 7 |
| cap | to | 6 |

| | | | |
|---|---|---|---|
| 6F6* | 6A4/LA | P | Parallel circuits only. Reverse 6A4/LA to 6F6 procedure. |
| | 6AD7 | G | Parallel circuits only. Remove and tape up any wires on Nos. 1 and 6. |
| | 6AR6 | G | Where additional filament current is available. Reverse 6AR6 to 6F6 procedure. |
| | 6G6 | P | Parallel circuits only. No changes. |
| | 6K6 | G | |
| | 6L6 | G | |
| | 6U6 | G | |
| | 6V6 | G | |
| | 7B5 | G | Same as 6K6 to 7B5. |
| | 7C5 | G | |
| | 38 | G | Parallel circuits only. Change socket to five prong and rewire as follows: |

| | | |
|---|---|---|
| No. 2 on octal | to No. | 1 on five prong |
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | cap |
| 7 | to | 5 |
| 8 | to | 4 |

| | | | |
|---|---|---|---|
| | 41 | G | Same as 6F6 to 42. Parallel circuits only. |
| | 42 | E | Change socket to six prong and rewire as follows: |

| | | |
|---|---|---|
| No. 2 on octal | to No. | 1 on six prong |
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | 4 |
| 7 | to | 6 |
| 8 | to | 5 |

| | | | |
|---|---|---|---|
| | 89 | G | Parallel circuits only. Change socket to six prong and rewire as follows: |

| | | |
|---|---|---|
| No. 2 on octal | to No. | 1 on six prong |
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | cap |
| 7 | to | 6 |
| 8 | to | 5 |
| short 4 and 5 together. | | |

| | | | |
|---|---|---|---|
| 6F7 | 6P7 | E | Change socket to octal and rewire as follows: |

| | | |
|---|---|---|
| No. 1 on seven prong | to No. | 2 on octal |
| 2 | to | 4 |
| 3 | to | 5 |
| 4 | to | 6 |
| 5 | to | 7 |
| 6 | to | 8 |
| 7 | to | 3 |
| cap | to | cap |

| | | | |
|---|---|---|---|
| 6F8 | 6C8 | G | Parallel circuits only. No changes. |

* See Addendum at back of this section.

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6G5 | 6AB5 | G | Parallel circuits only. No changes. |
| | 6E5 | G | No changes. |
| | 6T5 | G | |
| | 6U5 | G | |
| 6G6 | 6A4/LA | G | Parallel circuits only. Reverse 6A4/LA to 6F6 procedure. |
| | 6F6 | G | Parallel circuits only. No changes. |
| | 6K6 | G | |
| | 6V6 | G | |
| | 12A6 | P | Series circuits only. No changes. |
| | 41 | G | Same as 6F6 to 42. Parallel circuits only. |
| | 42 | G | |
| | 89 | G | Same as 6F6 to 89. Parallel circuits only. |
| 6H4 | 6H6 | G | Parallel circuits only. Rewire as follows:<br>No. 4 to No. 3<br>Connect No. 3 and No. 5 together.<br>Connect No. 4 and No. 8 together. |
| 6H5 | 6U5/6G5 | E | No changes. |
| 6H6 | 6AL5 | G | Same as 12H6 to 12AL5. |
| | 6W5 | P | Parallel circuits only. Tie Nos. 4 and 8 together. |
| | 6X5 | P | |
| | 6ZY5 | P | Tie Nos. 4 and 8 together. |
| | 7A6 | E | Parallel circuits only. Change socket to loctal and rewire as follows:<br>No. 1 on octal to No. 5 on loctal<br>2 to 1<br>3 to 3<br>4 to 2<br>5 to 6<br>7 to 8<br>8 to 7<br> <br> |
| | 7Y4 | P | Parallel circuits only. Change socket to loctal and rewire as follows:<br>No. 2 on octal to No. 1 on loctal<br>3 to 3<br>4 and 8 to 7<br>5 to 6<br>7 to 8<br>8 to 7<br> <br> |
| | 7Z4 | P | |
| 6H8 | | | No practical substitute. |
| 6J4 | 6AB4 | P | Parallel circuits only. Rewire as follows:<br>Nos. 1 and 5 to 6<br>7 to 1<br>2 to 7 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6J4 | 6C4 | G | Parallel circuits only. Reverse 6C4 to 6J4 procedure. |
| | 6N4 | G | Parallel circuits only. Rewire as follows:<br>Reverse Nos. 5 and 7<br>No. 6 to No. 7 |
| | 9002 | G | Parallel circuits only. Rewire as follows:<br>Nos. 1 and 5 to No. 6<br>7 to 1 |
| 6J5 | 6AD5 | G | No changes. |
| | 6AE5 | G | |
| | 6AF5 | G | |
| | 6C5 | G | |
| | 6F5 | G | Same as 6C5 to 6F5. |
| | 6K5 | G | Change connections as follows: No. 5 to cap. |
| | 6L5 | G | Parallel circuits only. No changes. |
| | 6P5 | G | No changes. |
| | 7A4 | E | Change socket to loctal and rewire as follows: |
| | XXL | E | No. 2 on octal to No. 1 on loctal<br>3 to 2<br>5 to 6<br>7 to 8<br>8 to 7 |
| | 37 | G | Same as 6C5 to 37. |
| | 76 | G | |
| 6J6 | 5687 | P | Parallel circuits only. Change socket to noval and rewire as follows: |
| | | | No. 1 on miniature to No. 9 on noval<br>2 to 1<br>3 to 4<br>4 to 5<br>5 to 2<br>6 to 7<br>7 to 3 and 6 |
| 6J7* | 6C6 | E | Reverse 6C6 to 6J7 procedure. |
| | 6D6 | E | |
| | 6D7 | G | Change socket to seven prong and rewire as follows: |
| | 6E7 | G | No. 2 on octal to No. 1 on seven prong<br>3 to 2<br>4 to 3<br>5 to 4<br>7 to 7<br>8 to 6<br>cap to cap |
| | 6K7 | G | No changes. |
| | 6S7 | G | Parallel circuits only. No changes. |

* See Addendum at back of this section.

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6J7 | 6SH7 | G | Make adaptor as follows: |
| | 6SJ7 | E | |
| | 6SK7 | G | |

| No. 1 on base | to No. 1 on top |
|---|---|
| 2 | to 2 |
| 3 | to 8 |
| 4 | to 6 |
| 5 | to 3 |
| 7 | to 7 |
| 8 | to 5 |
| cap | to 4 |

| | | | |
|---|---|---|---|
| | 6U7 | G | No changes. |
| | 6W7 | G | Parallel circuits only. No changes. |
| | 7A7 | G | Change socket to loctal and rewire as follows: |
| | 7H7 | G | |
| | 7L7 | G | |

| No. 1 on octal | to No. 5 on loctal |
|---|---|
| 2 | to 1 |
| 3 | to 2 |
| 4 | to 3 |
| 5 | to 4 |
| 7 | to 8 |
| 8 | to 7 |
| cap | to 6 |

| | | | |
|---|---|---|---|
| | 7B7 | G | Same as 6J7 to 7L7. Parallel circuits only. |
| | 7C7 | G | |
| | 7G7 | G | Same as 6J7 to 7L7 |
| | 39/44 | G | Same as 6K7 to 39/44. |
| | 36 | G | |
| | 77 | E | Reverse 6C6 to 6J7 procedure. |
| | 78 | G | |
| | 1221 | E | Reverse 6C6 to 6J7 procedure. |
| | 1223 | E | No changes. |
| | 1232 | E | Same as 6J7 to 6L7. |
| | 1620 | E | No changes. |
| 6J8 | 6A7 | G | Same as 6A8 to 6A7. |
| | 6A8 | G | No changes. |
| | 6D8 | G | Parallel circuits only. No changes. |
| | 6K8 | G | No changes. |
| | 7A8 | G | Same as 6D8 to 7A8. Parallel circuits only. |
| | 7B8 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6J8 | 7J7 | G | Change socket to loctal and rewire as follows: |
| | 7S7 | G | |

| No. 2 on octal | to No. 1 on loctal |
|---|---|
| 3 | to 2 |
| 4 | to 5 |
| 5 | to 4 |
| 6 | to 3 |
| 7 | to 8 |
| 8 | to 7 |
| cap | to 6 |

| | | | |
|---|---|---|---|
| | 7Q7 | G | Same as 6A8 to 7Q7. |
| 6K4 | 6AD4 | E | No changes. |
| 6K5 | 6AD5 | G | Make adaptor as follows: |

| No. 2 on base | to No. 2 on cap |
|---|---|
| 3 | to 3 |
| 7 | to 7 |
| 8 | to 8 |

Connect grid cap to No. 5 on base. This substitution can also be made by merely connecting the grid cap to No. 5 on the socket.

| | | | |
|---|---|---|---|
| | 6AE5 | G | Change connection as follows: cap to No. 5. |
| | 6C5 | G | |
| | 6J5 | G | |
| | 6F5 | G | Change connections as follows: |

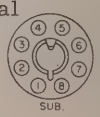
| No. 3 | to No. 4 |
|---|---|

| | | | |
|---|---|---|---|
| | 6Q7 | G | Cut off pins Nos. 4 and 5. |
| | 6SF5 | G | Make adaptor as follows: |

| No. 1 on base | to No. 1 on top |
|---|---|
| 2 | to 8 |
| 3 | to 5 |
| 7 | to 7 |
| 8 | to 2 |
| cap | to 3 |

| | | | |
|---|---|---|---|
| | 7A4 | G | Change socket to loctal and rewire as follows: |
| | 7B4 | G | |

| No. 2 on octal | to No. 1 on loctal |
|---|---|
| 3 | to 2 |
| 7 | to 8 |
| 8 | to 7 |
| cap | to 6 |




| | | | |
|---|---|---|---|
| 6K6 | 6A4/LA | P | Parallel circuits only. Reverse 6A4/LA to 6F6 procedure. |
| | 6AD7 | G | Parallel circuits only. Remove and tape up any wires anchored on pins Nos. 1 and 6. |
| | 6AR6 | P | Where additional filament current is available. Reverse 6AR6 to 6F6 procedure. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6K6 | 6F6 | G | Parallel circuits only. No changes. |
| | 6G6 | P | |
| | 6L6 | G | |
| | 6U6 | G | |
| | 6V6 | G | |
| | 7A5 | G | Same as 6K6 to 7B5. Parallel circuits only. |
| | 7B5 | E | Change socket to loctal and rewire as follows: |

| No. 2 on octal | to No. 1 on loctal |
|---|---|
| 3 | to 2 |
| 4 | to 3 |
| 5 | to 6 |
| 7 | to 8 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| | 7C5 | G | Same as 6K6 to 7B5. Parallel circuits only. |
| | 38 | G | Same as 6F6 to 38. Parallel circuits only. |
| | 41 | E | Same as 6F6 to 42. Parallel or series circuits. |
| | 42 | G | Same as 6F6 to 42. Parallel circuits only. |
| | 89 | G | Same as 6F6 to 89. Parallel or series circuits. |
| 6K7 | 6AU6 | G | Change socket to miniature and rewire as follows: |
| | 6BA6 | G | |
| | 6BD6 | G | |

| No. 2 on octal | to No. 3 on miniature |
|---|---|
| 3 | to 5 |
| 4 | to 6 |
| 5 | to 2 |
| 7 | to 4 |
| 8 | to 7 |
| cap | to 1 |

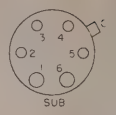
| | | | |
|---|---|---|---|
| | 6C6 | G | Reverse 6C6 to 6J7 procedure. |
| | 6D6 | E | |
| | 6D7 | G | Same as 6J7 to 6D7. |
| | 6E7 | G | |
| | 6J7 | G | No changes. |
| | 6Q7 | P | Cut off pins No. 4 and No. 5. Emergency substitution. |
| | 6S7 | G | Parallel circuits only. No changes. |
| | 6SH7 | G | Same as 6J7 to 6SJ7. |
| | 6SJ7 | G | |
| | 6SK7 | E | |
| | 6SS7 | G | Same as 12K7 to 12SK7. Parallel circuits only. |
| | 6U7 | G | No changes. |
| | 6W7 | G | Parallel circuits only. No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6K7 | XXL | P | Change socket to loctal and rewire as follows: |
| | 7A4 | P | Remove No. 4 and tape up<br>No. 2 on octal to No. 1 on loctal<br>3 to 2<br>8 to 7<br>7 to 8<br>cap to 6 |
| | 7A7 | E | Change socket to loctal and rewire as follows: |
| | 7J7 | G | |
| | 7L7 | G | No. 1 on octal to No. 5 on loctal<br>2 to 1<br>3 to 2<br>4 to 3<br>5 to 4<br>7 to 8<br>8 to 7<br>cap to 6 |
| | 7B7 | G | Same as 6K7 to 7A7. Parallel circuits only. |
| | 7C7 | G | |
| | 7G7 | G | |
| | 39/44 | E | Change socket to five prong type and rewire as follows: |
| | | | No. 2 on octal to No. 1 on five prong<br>3 to 2<br>4 to 3<br>5 to 4<br>7 to 5<br>8 to 4<br>cap to cap |
| | 77 | G | Reverse 6C6 to 6J7 procedure. |
| | 78 | E | |
| | 1232 | G | Same as 6K7 to 7A7. Parallel circuits only. |
| 6K8 | 6A8 | G | No changes. |
| | 6J8 | G | |
| | 7J7 | G | Same as 6J8 to 7J7. |
| | 7S7 | G | |
| | 7Q7 | G | Same as 12A8 to 14B8. |
| 6L4 | 6F4 | P | No changes. |
| | 955 | G | Parallel circuits only. Refer to base diagram for changes. |
| 6L5 | 6AD5 | G | Parallel circuits only. No changes. |
| | 6AE5 | G | |
| | 6C5 | G | Parallel circuits only. No changes. |
| | 7A4 | G | Same as 6J5 to 7A4. Parallel circuits only. |
| | XXL | G | |
| | 37 | G | Same as 6C5 to 37. Parallel circuits only. |
| | 76 | G | |
| 6L6 | 6AD7 | G | Remove and tape up any wires anchored on pins Nos. 1 and 6. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6L6 | 6AL6 | G | Rewire as follows:<br>Connect No. 3 to cap. |
| | 6AR6 | G | Reverse 6AR6 to 6F6 procedure. |
| | 6F6 | G | Parallel circuits only. No changes. |
| | 6K6 | G | |
| | 6U6 | G | |
| | 6V6 | G | |
| | 1614 | E | No changes. |
| 6L7 | 1612 | E | No changes. |
| 6M5 | | | No practical substitute. |
| 6M6G | | | No practical substitute. |
| 6M7G | | | No practical substitute. |
| 6M8GT | | | No practical substitute. |
| 6N4 | 6AB4 | G | Parallel circuits only. Reverse 6AB4 to 6N4 procedure. |
| | 6J4 | G | Parallel circuits only. Reverse 6J4 to 6N4 procedure. |
| 6N5 | 6AB5 | E | See 6AB5 substitutes. |
| 6N6 | 6AB6 | G | Parallel circuits only. No changes. |
| | 6B5 | E | Change socket to six prong and rewire as follows:<br>No. 2 on octal to No. 1 on six prong<br>3 to 2<br>4 to 3<br>5 to 4<br>7 to 6<br>8 to 5 |
| 6N7 | 6A6 | G | Change socket to seven prong and rewire as follows:<br>No. 2 on octal to No. 1 on seven prong<br>3 to 2<br>4 to 3<br>5 to 5<br>6 to 6<br>7 to 7<br>8 to 4 |
| | 6AE6 | P | Parallel circuits only. Reverse 6AE6 to 6N7 procedure. |
| | 6Y7 | G | Parallel circuits only. No changes. |
| | 6Z7 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6N7 | 79 | G | Change socket to six prong and rewire as follows: |

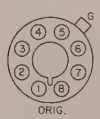
| No. 2 on octal | to No. 1 on six prong |
|---|---|
| 3 | to 2 |
| 4 | to 3 |
| 5 | to cap |
| 6 | to 5 |
| 7 | to 6 |
| 8 | to 4 |




6N8 7R7 P Change socket to loctal and rewire as follows:

| No. 1 on noval | to No. 5 on loctal |
|---|---|
| 2 | to 6 |
| 3 | to 7 |
| 4 | to 1 |
| 5 | to 8 |
| 6 | to 2 |
| 7 | to 3 |
| 8 | to 4 |
| 9 | to 7 |

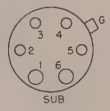
| | | | |
|---|---|---|---|
| 6P5 | 6AD5 | G | No changes. |
| | 6AE5 | G | |
| | 6AF5 | G | |
| | 6C5 | G | |
| | 6J5 | G | |
| | 6L5 | G | Parallel circuits only. No changes. |
| | 7A4 | G | Same as 6J5 to 7A4. |
| | 37 | G | Same as 6C5 to 37. |
| | 76 | G | |
| 6P7 | 6F7 | E | Change socket to seven prong and rewire as follows: |




| No. 2 on octal | to No. 1 on seven prong |
|---|---|
| 3 | to 7 |
| 4 | to 2 |
| 5 | to 3 |
| 6 | to 4 |
| 7 | to 5 |
| 8 | to 6 |
| cap | to cap |

| | | | |
|---|---|---|---|
| 6P8G | | | No practical substitute. |
| 6Q5G | | | No practical substitute. |
| 6Q6 | | | No practical substitute. |
| 6Q7 | 6B6 | E | No changes. |
| | 6C7 | G | Change socket to seven prong type and rewire as follows: |

| No. 2 on octal | to No. 1 on seven prong |
|---|---|
| 3 | to 2 |
| 4 | to 4 |
| 5 | to 5 |
| 7 | to 7 |
| 8 | to 6 |
| cap | to cap |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6Q7 | 6SQ7<br>6SR7 | E<br>G | Same as 12Q7 to 12SQ7. |
| | 6R7 | G | No changes. |
| | 6T7 | G | Parallel circuits. No changes. |
| | 6V7 | G | No changes. |
| | 7B6<br>7E6 | E<br>G | Change socket to loctal and rewire as follows:<br>No. 2 on octal to No. 1 on loctal<br>3 to 2<br>4 to 5<br>5 to 6<br>7 to 8<br>8 to 7 or 4<br>cap to 3<br> <br> |
| | 7C6 | G | Same as above. Parallel circuits only. |
| | 75<br>85 | E<br>G | Change socket to six prong type and rewire as follows:<br>No. 2 on octal to No. 1 on six prong<br>3 to 2<br>4 to 3<br>5 to 4<br>7 to 6<br>8 to 5<br>cap to cap<br> <br>  |
| 6R4 | | | No practical substitute. |
| 6R6 | 6K7<br>6U7 | G<br>G | Rewire as follows:<br>No. 3 to No. 4<br>5 to 3<br>Short Nos. 5 and 8 on socket together. |
| 6R7 | 6C7 | G | Same as 6Q7 to 6C7. |
| | 6Q7 | G | No changes. |
| | 6SQ7<br>6SR7 | G<br>E | Same as 12Q7 to 12SQ7. |
| | 6T7 | G | Parallel circuits only. No changes. |
| | 6V7 | G | No changes. |
| | 7B6 | G | Same as 6Q7 to 7B6. |
| | 7C6 | E | Parallel circuits only. Same as 6Q7 to 7B6. |
| | 7E6 | G | Same as 6Q7 to 7B6. |
| | 75<br>85 | G<br>E | Same as 6Q7 to 75. |
| 6R8 | 6T8 | G | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6S6 | | | No practical substitute. |
| 6SA7 | 7Q7 | G | Same as 12SA7 to 14Q7. |
| | 6SB7Y | G | No changes. |
| | 6SD7 | P | Same as 12SA7 to 12SK7. |
| | 6SH7 | P | |
| | 6SK7 | P | |
| 6S7 | 6D6 | G | Parallel circuits only. Reverse 6C6 to 6J7 procedure. |
| | 6D7 | G | Same as 6J7 to 6D7. Parallel circuits only. |
| | 6E7 | G | |
| | 6J7 | G | Parallel circuits only. No changes. |
| | 6K7 | G | |
| | 6SJ7 | G | Parallel circuits only. Same as 12K7 to 12SK7. |
| | 6SK7 | G | |
| | 6SS7 | E | Same as 12K7 to 12SK7. |
| | 6U7 | G | Parallel circuits only. No changes. |
| | 6W7 | G | No changes. |
| | 7A7 | G | Parallel circuits only. Same as 12K7 to 7B7. |
| | 7B7 | G | Same as 12K7 to 7B7. |
| | 7C7 | G | |
| | 12K7 | P | Series circuits only. No changes. |
| | 12SK7 | P | Series circuits only. Same as 12K7 to 12SK7. |
| | 14A7/12B7 | P | Series circuits only. Same as 12K7 to 7B7. |
| | 39/44 | G | Parallel circuits only. Same as 6K7 to 39/44. |
| | 77 | G | Parallel circuits only. Reverse 6C6 to 6J7 procedure. |
| | 78 | G | |
| | 666 | G | |
| 6SB7Y | 6BE6 | G | Change socket to miniature and rewire as follows: |

| No. 1 on octal | to No. | 2 on miniature |
|---|---|---|
| 2 | to | 3 |
| 3 | to | 5 |
| 4 | to | 6 |
| 5 | to | 1 |
| 6 | to | 2 |
| 7 | to | 4 |
| 8 | to | 7 |

| | | | |
|---|---|---|---|
| 6SC7 | 6C8 | G | Same as 6SC7 to 6F8. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6SC7 | 6F8 | G | Make adaptor as follows:<br>No. 1 on base to No. 1 on top<br>2 to 3<br>3 to cap<br>4 to 5<br>5 to 6<br>6 to 4 and 8<br>7 to 7<br>8 to 2<br>Parallel circuits only. |
| | 6SL7 | G | Make adaptor as follows:<br>No. 2 on base to No. 2 on top<br>3 to 1<br>4 to 4<br>5 to 5<br>6 to 3 and 6<br>7 to 7<br>8 to 8 |
| | 6SN7 | G | Same as 6SC7 to 6SL7. Parallel circuits only. |
| | 7F7 | G | Change socket to loctal and rewire as follows:<br>No. 2 on octal to No. 3 on loctal<br>3 to 4<br>4 to 5<br>5 to 6<br>6 to 2 and 7<br>7 to 1<br>8 to 8<br> <br> |
| 6SD7 | 6AB7/1853 | G | Parallel circuits only. No changes. |
| | 6AC7/1852 | G | |
| | 6SS7 | G | |
| | 6SE7 | G | No changes. |
| | 6SJ7 | G | No changes. |
| | 6SK7 | G | |
| | 5693 | G | |
| 6SE7 | 6AB7/1853 | G | Parallel circuits only. No changes. |
| | 6AC7/1852 | G | |
| | 6SS7 | G | |
| | 6SD7 | G | No changes. |
| | 6SJ7 | G | No changes. |
| | 6SK7 | G | |
| | 5693 | G | |
| 6SF5 | 6F5 | E | Reverse 6F5 to 6SF5 procedure. |
| | 6K5 | G | Make adaptor as follows:<br>No. 1 on base to No. 1 on top<br>2 to 8<br>3 to cap<br>5 to 3<br>7 to 7<br>8 to 2 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6SF5 | 7B4 | G | Change socket to loctal and rewire as follows. Parallel circuits only: |

| No. 2 on octal | to No. 7 on loctal |
|---|---|
| 3 | to 6 |
| 5 | to 2 |
| 7 | to 1 |
| 8 | to 8 |

| | | | |
|---|---|---|---|
| 6SF7 | 6SV7 | G | No changes. |
| 6SG7 | 6AB7 | G | Parallel circuits only. No changes. |
| | 6AC7 | G | |
| | 6AG5 | G | Change socket to miniature and rewire as follows: |
| | 6BC5 | G | |

| No. 2 on octal | to No. 3 on miniature |
|---|---|
| 3 and 5 | to 2 |
| 4 | to 1 |
| 6 | to 6 |
| 7 | to 4 |
| 8 | to 5 |

| | | | |
|---|---|---|---|
| | 6AJ5 | G | Same as 6SG7 to 6AG5. Parallel circuits only. |
| | 6AK5 | G | |
| | 6AN5 | G | |
| | 5591 | G | |
| | 9001 | G | |
| | 9003 | G | |
| | 6SH7 | G | No changes. Cathode and suppressor grid are internally connected in the |
| | 6SJ7 | G | 6SG7. In a limited number of circuits this substitution does operate. In |
| | 6SK7 | G | these cases short pins 3 and 5 together. |
| 6SH7 | 6AB7 | G | Parallel circuits only. No changes. |
| | 6AC7 | G | |
| | 6AG5 | G | Same as 6SG7 to 6AG5. |
| | 6BC5 | G | |
| | 6AJ5 | G | Same as 6SG7 to 6AG5. Parallel circuits only. |
| | 6AK5 | G | |
| | 6AN5 | G | |
| | 5591 | G | |
| | 9001 | G | |
| | 9003 | G | |
| | 6SG7 | G | No changes. |
| | 6SJ7 | G | |
| | 6SK7 | G | |
| | 7G7/1232 | G | Parallel circuits only. Change socket to loctal and rewire as follows: |

| No. 1 on octal | to No. 5 on loctal |
|---|---|
| 2 | to 1 |
| 3 | to 4 |
| 4 | to 6 |
| 5 | to 7 |
| 6 | to 3 |
| 7 | to 8 |
| 8 | to 2 |

| | | | |
|---|---|---|---|
| 6SJ7 | 6C6 | E | Reverse 6C6 to 6SJ7 procedure. |
| | 6D6 | G | |
| | 77 | E | |
| | 78 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6SJ7 | 6D7 | G | Change socket to seven prong type and rewire as follows: |
| | 6E7 | G | |

| No. 2 on octal | to No. | 1 on seven prong |
|---|---|---|
| 3 | to | 4 |
| 4 | to | cap |
| 5 | to | 6 |
| 6 | to | 3 |
| 7 | to | 7 |
| 8 | to | 2 |

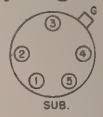
| | | | |
|---|---|---|---|
| | 6J7 | E | Same as 12SK7 to 12K7. |
| | 6K7 | G | |
| | 6U7 | G | |
| | 6S7 | G | Same as 12SK7 to 12K7. Parallel circuits only. |
| | 6W7 | G | |
| | 6SK7 | G | No changes. |
| | 5693 | E | |
| | 6SS7 | G | Parallel circuits only. No changes. |
| | 7A7 | G | Same as 12SJ7 to 7B7. |
| | 7H7 | G | |
| | 7B7 | G | Same as 12SJ7 to 7B7. Parallel circuits only. |
| | 7C7 | G | |
| 6SK7 | 6AB7 | G | Parallel circuits only. No changes. |
| | 6AC7 | G | |
| | 6AH6 | G | Same as 6SK7 to 6AU6. Parallel circuits only. |
| | 6AK6 | G | |
| | 6AU6 | G | Change socket to miniature and rewire as follows: |
| | 6BA6 | G | |
| | 6BD6 | G | |

| No. 2 on octal | to No. | 3 on miniature |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 1 |
| 5 | to | 7 |
| 6 | to | 6 |
| 7 | to | 4 |
| 8 | to | 5 |

| | | | |
|---|---|---|---|
| | 6C6 | G | Reverse 6C6 to 6SJ7 procedure. |
| | 6D6 | E | |
| | 77 | G | |
| | 78 | E | |
| | 6D7 | G | Same as 6SJ7 to 6D7. |
| | 6E7 | G | |
| | 6J7 | G | Same as 12SK7 to 12K7. |
| | 6K7 | E | |
| | 6U7 | G | |
| | 6S7 | G | Same as 12SK7 to 12K7. Parallel circuits only. |
| | 6W7 | G | |
| | 6SG7 | G | No changes. |
| | 6SH7 | G | |
| | 6SJ7 | G | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6SK7 | 6SS7 | G | Parallel circuits only. No changes. |
| | 36 | G | Change socket to five prong and rewire as follows: |
| | 39/44 | E | |

| No. 2 on octal | to No. 1 on five prong |
|---|---|
| 3 and 5 | to 4 |
| 4 | to cap |
| 6 | to 3 |
| 7 | to 5 |
| 8 | to 2 |




| | | | |
|---|---|---|---|
| | 7A7 | E | Same as 12SJ7 to 7B7. |
| | 7B7 | E | Same as 12SJ7 to 7B7. Parallel circuits only. |
| | 7C7 | G | |
| 6SL7 | 2C21 | P | Reverse 2C21 to 6SN7 procedure. |
| | 6C8 | G | Same as 6SL7 to 6F8. |
| | 6F8 | G | Make adaptor as follows: |

| No. 1 on base | to cap on top |
|---|---|
| 2 | to 3 |
| 3 | to 4 |
| 4 | to 5 |
| 5 | to 6 |
| 6 | to 8 |
| 7 | to 7 |
| 8 | to 2 |

| | | | |
|---|---|---|---|
| | 6SC7 | G | If the 6SL7 employs the two cathodes separately this substitution may be impractical. Reverse 6SC7 to 6SL7 procedure. |
| | 6SN7 | G | Parallel circuits only. No changes. |
| | 6SU7 | G | No changes. |
| | 7F7 | G | Change socket to loctal and rewire as follows: |

| No. 1 on octal | to No. 4 on loctal |
|---|---|
| 2 | to 3 |
| 3 | to 2 |
| 4 | to 5 |
| 5 | to 6 |
| 6 | to 7 |
| 7 | to 1 |
| 8 | to 8 |

| | | | |
|---|---|---|---|
| | 7N7 | G | Same as 6SL7 to 7F7. Parallel circuits only. |
| | 5691 | E | No changes. |
| | 5692 | P | |
| 6SN7 | 2C21 | G | Reverse 2C21 to 6SN7 procedure. |
| | 6F8 | G | Same as 6SL7 to 6F8. Parallel circuits only. |
| | 6SC7 | G | Reverse 6SC7 to 6SL7 procedure. Parallel circuits only. |
| | 6SL7 | G | Parallel circuits only. No changes. |
| | 7F7 | G | Same as 6SL7 to 7F7. Parallel circuits only. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6SN7 | 7F8 | G | Parallel circuits only. Change socket to loctal and rewire as follows: |

| No. | | No. |
|---|---|---|
| 1 on octal | to | 1 on loctal |
| 2 | to | 3 |
| 3 | to | 4 |
| 4 | to | 8 |
| 5 | to | 6 |
| 6 | to | 5 |
| 7 | to | 7 |
| 8 | to | 2 |

| | | | |
|---|---|---|---|
| | 5691 | P | No changes. |
| | 5692 | G | |
| 6SQ7 | 6AQ6 | G | Same as 6SQ7 to 6AT6. Parallel circuits only. |
| | 6AT6 | G | Change socket to miniature and rewire as follows: |
| | 6AV6 | G | |
| | 6BF6 | G | |
| | 6BK6 | G | |
| | 6BT6 | G | |
| | 6BU6 | G | |

| No. | | No. |
|---|---|---|
| 2 on octal | to | 1 on miniature |
| 3 | to | 2 |
| 4 | to | 5 |
| 5 | to | 6 |
| 6 | to | 7 |
| 7 | to | 4 |
| 8 | to | 3 |

| | | | |
|---|---|---|---|
| | 6B6 | G | Make adaptor as follows: |

| No. | | No. |
|---|---|---|
| 1 on base | to | 1 on top |
| 2 | to | cap |
| 3 | to | 8 |
| 4 | to | 4 |
| 5 | to | 5 |
| 7 | to | 7 |
| 8 | to | 2 |

| | | | |
|---|---|---|---|
| | 6C7 | G | Change socket to seven prong and rewire as follows: |

| No. | | |
|---|---|---|
| 2 on octal | to | cap on seven prong |
| 3 | to | 6 |
| 4 | to | 4 |
| 5 | to | 5 |
| 6 | to | 2 |
| 7 | to | 1 |
| 8 | to | 7 |

| | | | |
|---|---|---|---|
| | 6Q7 | E | Same as 6SQ7 to 6B6. |
| | 6R7 | G | Same as 6SQ7 to 6B6. |
| | 6SR7 | G | No changes. |
| | 6ST7 | G | Parallel circuits only. No changes. |
| | 6T7 | G | Same as 6SQ7 to 6B6. Parallel circuits only. |
| | 6V7 | G | |
| | 7B6 | E | Change socket to loctal and rewire as follows: |
| | 7E6 | G | |

| No. | | No. |
|---|---|---|
| 2 on octal | to | 3 on loctal |
| 3 | to | 4 or 7 |
| 4 | to | 5 |
| 5 | to | 6 |
| 6 | to | 2 |
| 7 | to | 1 |
| 8 | to | 8 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6SQ7 | 7C6 | G | Same as above. Parallel circuits only. |
| | 75 | E | Change socket to six prong and rewire as follows: |
| | 85 | G | No. 2 on octal to cap on six prong<br>3 to 5<br>4 to 3<br>5 to 4<br>6 to 2<br>7 to 1<br>8 to 6 |
| 6SR7 | 6AQ6 | G | Same as 6SQ7 to 6AT6. Parallel circuits only. |
| | 6AT6 | G | Same as 6SQ7 to 6AT6. |
| | 6AV6 | G | |
| | 6BF6 | G | |
| | 6BK6 | G | |
| | 6BT6 | G | |
| | 6BU6 | G | |
| | 6B6 | G | Same as 6SQ7 to 6B6. |
| | 6Q7 | G | |
| | 6C7 | G | Same as 6SQ7 to 6C7. |
| | 6R7 | E | Same as 6SQ7 to 6B6. |
| | 6V7 | G | |
| | 6SQ7 | G | No changes. |
| | 6ST7 | G | Parallel circuits only. No changes. |
| | 6SZ7 | G | Parallel circuits only. No changes. |
| | 6T7 | G | Same as 6SQ7 to 6B6. Parallel circuits only. |
| | 75 | G | Same as 6SQ7 to 75. |
| | 85 | E | |
| 6SS7 | 6AK6 | G | Same as 6SK7 to 6AU6. |
| | 6AH6 | G | Same as 6SK7 to 6AU6. Parallel circuits only. |
| | 6AU6 | G | |
| | 6BA6 | G | |
| | 6BD6 | G | |
| | 6S7 | G | Same as 12SK7 to 12K7. |
| | 6SG7 | E | |
| | 6W7 | E | |
| | 6SJ7 | G | Parallel circuits only. No changes. |
| | 6SK7 | G | |
| | 7B7 | G | Same as 12SJ7 to 7B7. |
| | 7C7 | G | |
| | 12K7 | P | Same as 12SK7 to 12K7. Series circuits only. |
| | 12SK7 | P | Series circuits only. No changes. |
| | 14A7/12B7 | P | Same as 12SJ7 to 7B7. Series circuits only. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6ST7 | 6SQ7 | G | Parallel circuits only. No changes. |
| | 6SR7 | G | |
| | 6T7 | E | Same as 6SQ7 to 6B6. |
| 6SU7 | 6SL7 | E | No changes. |
| | 6SN7 | P | |
| 6SV7 | 6SF7 | G | No changes. |
| 6SZ7 | 6SQ7 | G | Parallel circuits only. No changes. |
| | 6SR7 | G | |
| | 6ST7 | G | No changes. |
| 6T5 | 2E5 | E | Heater voltage-current ratings differ. |
| | 6AB5 | G | Parallel circuits only. No changes. |
| | 6E5 | G | No changes. |
| | 6G5 | G | |
| | 6U5 | G | |
| 6T6 | | | No practical substitute. |
| 6T7 | 6B6 | G | Parallel circuits only. No changes. |
| | 6Q7 | G | Parallel circuits only. No changes. |
| | 6R7 | G | |
| | 6SQ7 | G | Same as 12Q7 to 12SQ7. Parallel circuits only. |
| | 6ST7 | E | Same as 12Q7 to 12SQ7. |
| | 6V7 | G | Parallel circuits only. No changes. |
| | 7B6 | G | Same as 6Q7 to 7B6. Parallel circuits only. |
| | 7C6 | G | Same as 6Q7 to 7B6. |
| | 12Q7 | P | Series circuits only. No changes. |
| | 12SQ7 | P | Same as 12Q7 to 12SQ7. Series circuits only. |
| | 75 | G | Same as 6Q7 to 75. Parallel circuits only. |
| | 85 | G | |
| 6T8* | 6R8 | G | No changes. |
| 6U4 | 6W4 | E | No changes. |
| 6U5/6G5 | 6N5 | E | Parallel circuits only. No changes. |
| | 6E5 | E | No changes. |
| 6U6 | 6A4/LA | P | Parallel circuits only. Reverse 6A4/LA to 6F6 procedure. |
| | 6AR6 | P | Where additional filament current is available. Reverse 6AR6 to 6F6 procedure. |



* See Addendum at back of this section.

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6U6 | 6F6 | G | Parallel circuits. No changes. |
| | 6G6 | P | |
| | 6K6 | G | |
| | 6L6 | P | |
| | 6V6 | G | |
| | 6W6 | P | |
| 6U7 | 6AU6 | G | Same as 6K7 to 6AU6. |
| | 6BA6 | G | |
| | 6BD6 | G | |
| | 6C6-77 | G | Reverse 6C6 to 6J7 procedure. |
| | 6D6-78 | G | |
| | 6D7 | G | Same as 6J7 to 6D7. |
| | 6E7 | G | |
| | 6K7 | G | No changes. |
| | 6S7 | G | Same as 6J7 to 6SJ7. |
| | 6SH7 | G | |
| | 6SJ7 | G | |
| | 6SK7 | G | |
| | 6SS7 | G | |
| | 6W7 | G | |
| | 7A7 | G | Same as 6K7 to 7A7. |
| | 7B7 | G | Same as 6K7 to 7A7. Parallel circuits only. |
| | 7C7 | G | |
| | 7G7 | G | |
| | 36 | G | Same as 6K7 to 39/44. |
| | 39/44 | G | |
| 6V4 | 6X4 | E | Reverse 6X4 to 6V4 procedure. |
| | 6X5 | G | Where space permits, reverse 6X5 to 6V4 procedure. |
| 6V6 | 6A4/LA | P | Parallel circuits only. Reverse 6A4/LA to 6F6 procedure. |
| | 6AD7 | G | Parallel circuits only. Remove and tape up any wires anchored on pins Nos. 1 and 6. |
| | 6AQ5 | G | Reverse 6AQ5 to 6V6 procedure. |
| | 6AR6 | P | Where additional filament current is available. Reverse 6AR6 to 6F6 procedure. |
| | 6F6 | G | Parallel circuits only. No changes. |
| | 6G6 | P | |
| | 6K6 | G | |
| | 6L6 | G | Parallel circuits only. No changes. |
| | 6U6 | G | |
| | 6Y6 | G | |
| | 7A5 | G | Parallel circuits only. Remove and tape up any wires anchored on pins Nos. 1 and 6. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6V6 | 7B5 | G | Same as 6K6 to 7B5. |
| | 7C5 | G | |
| | 38 | G | Same as 6F6 to 38. Parallel circuits only. |
| | 41 | G | Same as 6F6 to 41. Parallel circuits only. |
| | 42 | G | |
| | 89 | G | Same as 6F6 to 89. Parallel circuits only. |
| 6V7 | 6C7 | G | Same as 6Q7 to 6C7. |
| | 6R7 | G | No changes. |
| | 6SQ7 | G | Same as 12Q7 to 12SQ7. |
| | 6SR7 | G | |
| | 6T7 | G | Parallel circuits only. No changes. |
| | 7B6 | G | Same as 6Q7 to 7B6. |
| | 7C6 | G | Same as 6Q7 to 7B6. Parallel circuits only. |
| | 7E6 | G | Same as 6Q7 to 7B6. |
| | 75 | G | Same as 6Q7 to 75. |
| | 85 | G | |
| 6W4 | 6U4 | E | No changes. |
| 6W5 | 0Z4 | G | No changes. Do not use where AC plate voltage exceeds 250 volts per plate. |
| | 6AX5 | G | Parallel circuits only. No changes. |
| | 6AX6 | E | Parallel circuits only. Tie No. 4 and No. 8 together. |
| | 6BY5 | G | Parallel circuits only. Rewire as follows:<br>Connect Nos. 1 and 8 together<br>No. 3 to No. 4 |
| | 6X5 | G | Parallel circuits only. No changes. |
| | 6ZY5 | G | |
| | 6Z6 | G | Parallel circuits only. Short Nos. 4 and 8. |
| | 7Y4 | G | Same as 6X5 to 7Y4. |
| | 7Z4 | G | |
| | 1274 | G | No changes. Parallel circuits only. |
| 6W6 | 6AR6 | G | Reverse 6AR6 to 6F6 procedure. |
| | 6L6 | G | Parallel circuits only. No changes. |
| 6W7 | 6C6-77 | G | Parallel circuits only. Reverse 6C6 to 6J7 procedure. |
| | 6D6-78 | G | |
| | 6D7 | G | Same as 6J7 to 6D7. Parallel circuits only. |
| | 6E7 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6W7 | 6J7 | G | Parallel circuits only. No changes. |
| | 6K7 | G | |
| | 6S7 | G | No changes. |
| | 6SH7 | G | Same as 6J7 to 6SJ7. Parallel circuits only. |
| | 6SJ7 | G | |
| | 6SK7 | G | |
| | 6U7 | G | Parallel circuits only. No changes. |
| | 7A7 | G | Same as 6K7 to 7A7. Parallel circuits only. |
| | 7B7 | G | Same as 6K7 to 7A7. |
| | 7C7 | G | |
| | 7H7 | G | Same as 6K7 to 7A7. Parallel circuits only. |
| | 7L7 | G | Same as 6K7 to 7A7. Parallel circuits only. |
| | 12J7 | P | No change. Series circuits only. |
| | 12K7 | P | |
| | 77-6C6 | G | Reverse 6C6 to 6J7 procedure. Parallel circuits only. |
| | 78-6D6 | G | |
| 6X4 | 6V4 | E | Change socket to noval and rewire as follows:<br>No. 1 on miniature to No. 1 on noval<br>3 to 4<br>4 to 5<br>6 to 7<br>7 to 3 |
| | 6X5 | E | Where space permits. Change socket to octal and rewire as follows:<br>No. 1 on miniature to No. 3 on octal<br>3 to 2<br>4 to 7<br>6 to 5<br>7 to 8 |
| | 84/6Z4 | G | Parallel circuits only. Where space permits, reverse 84/6Z4 to 6X4 procedure. |
| | 5726 | G | Parallel circuits only. Reverse 5726 to 6X4 procedure. |
| 6X5 | 6AX5 | G | Parallel circuits only. No changes. |
| | 6AX6 | G | Parallel circuits only. Tie no. 4 and no. 8 together. |
| | 6BY5 | G | Parallel circuits only. Rewire as follows:<br>Connect Nos. 1 and 8 together<br>No. 3 to No. 4 |
| | 6V4 | G | Change socket to noval and rewire as follows:<br>No. 2 on octal to No. 4 on noval<br>3 to 1<br>5 to 7<br>7 to 5<br>8 to 3 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6X5 | 6W5 | G | Parallel circuits only. No changes. |
| | 6X4 | G | Reverse 6X4 to 6X5 procedure. |
| | 6Y5 | E | Parallel circuits only. Change socket to six prong and rewire as follows: |

| No. 2 on octal | to No. | 1 on six prong |
|---|---|---|
| 3 | to | 3 |
| 5 | to | 5 |
| 7 | to | 6 |
| 8 | to | 4 |

| | | | |
|---|---|---|---|
| | 0Z4 | E | No changes. Do not use where AC plate voltage exceeds 250 volts per plate. |
| | 6Z5 | G | Same as 6X5 to 6Y5. Parallel circuits only. |
| | 6Z6 | G | Same as 6W5 to 6Z6. |
| | 6ZY5 | G | Parallel circuits only. No changes. |
| | 7Y4 | E | Parallel circuits only. Change socket to loctal and rewire as follows: |

| No. 2 on octal | to No. | 1 on loctal |
|---|---|---|
| 3 | to | 3 |
| 5 | to | 6 |
| 7 | to | 8 |
| 8 | to | 7 |

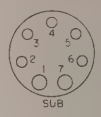
| | | | |
|---|---|---|---|
| | 7Z4 | G | Same as 6X5 to 7Y4. |
| | 84 | E | Change socket to five prong and rewire as follows: |

| No. 2 on octal | to No. | 1 on five prong |
|---|---|---|
| 3 | to | 2 |
| 5 | to | 3 |
| 7 | to | 5 |
| 8 | to | 4 |

| | | | |
|---|---|---|---|
| | 1274 | G | Parallel circuits only. No changes. |
| 6X6G | | | No practical substitute. |
| 6Y3G | | | No practical substitute. |
| 6Y5 | 6X5 | G | Parallel circuits only. Reverse 6X5 to 6Y5 procedure. |
| | 6Z5 | G | Rewire as follows: Connect Nos. 2 and 6 together. |
| 6Y6 | 6AR6 | G | Reverse 6AR6 to 6F6 procedure. |
| | 6G6 | P | Parallel circuits only. No changes. |
| | 6K6 | G | |
| | 6L6 | G | |
| | 6U6 | G | |
| | 6V6 | G | |
| | 7A5 | G | Same as 6K6 to 7B5. Parallel circuits only. |
| | 7B5 | G | Same as 6K6 to 7B5. Parallel circuits only. |
| | 7C5 | G | |

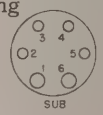
| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6Y7* | 6A6 | G | Change socket to seven prong and rewire as follows: |

| | |
|---|---|
| No. 2 on octal | to No. 1 on seven prong |
| 3 | to 2 |
| 4 | to 3 |
| 5 | to 5 |
| 6 | to 6 |
| 7 | to 7 |
| 8 | to 4 |




| | | | |
|---|---|---|---|
| | 6N7 | G | Parallel circuits only. No changes. |
| | 6Z7 | G | |
| 6Z3 | 1V | E | No changes. |
| 6Z4 | 6Y5 | G | Parallel circuits only. Change socket to six prong and rewire as follows: |

| | |
|---|---|
| No. 1 on five prong | to No. 3 on six prong |
| 2 | to 5 |
| 3 | to 4 |
| 4 | to 6 |
| 5 | to |




| | | | |
|---|---|---|---|
| 6Z5 | 6Y5 | E | No changes for six volt operation. |
| 6Z7 | 6A6 | G | Same as 6Y7 to 6A6. Parallel circuits only. |
| | 6N7 | G | Parallel circuits only. No changes. |
| | 6Y7 | G | |
| 6ZY5 | 0Z4 | G | No changes. Do not use where AC plate voltage exceeds 250 volts per plate. |
| | 6AX5 | G | Paralled circuits only. No changes. |
| | 6AX6 | G | Parallel circuits only. Tie Nos. 4 and 8 together. |
| | 6BY5 | G | Parallel circuits only. Rewire as follows: |

Connect Nos. 1 and 8 together
No. 3 to No. 4

| | | | |
|---|---|---|---|
| | 6W5 | G | Parallel circuits only. No changes. |
| | 6X5 | G | Parallel circuits only. No changes. |
| | 6Y5 | G | Same as 6X5 to 6Y5. Parallel circuits only. |
| | 6Z5 | G | |
| | 7Y4 | G | Same as 6X5 to 7Y4. Parallel circuits only. |
| | 7Z4 | G | |
| | 84 | G | Same as 6X5 to 84. Parallel circuits only. |
| | 1274 | G | Parallel circuits only. No changes. |

* See Addendum at back of this section.

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 7A4 | 6AE5 | G | Change socket to octal and rewire as follows: |

| | | |
|---|---|---|
| No. 2 on loctal | to No. | 3 on octal |
| 1 | to | 2 |
| 6 | to | 5 |
| 7 | to | 8 |
| 8 | to | 7 |

| | | | |
|---|---|---|---|
| | 6C5 | G | Reverse 6J5 to 7A4 procedure. |
| | 6J5 | G | Reverse 6J5 to 7A4 procedure. |
| | 6L5 | G | Same as 7A4 to 6AE5. Parallel circuits only. |
| | 7B4 | G | No changes. |
| | XXL | E | |
| | 37 | G | Change socket to five prong and rewire as follows |
| | 76 | G | |

| | |
|---|---|
| No. 1 on loctal | to No. 1 on five prong |
| 2 | to 2 |
| 6 | to 3 |
| 7 | to 4 |
| 8 | to 5 |

| | | | |
|---|---|---|---|
| 7A5 | 6F6 | E | Parallel circuits only. Change socket to octal and rewire as follows. |
| | 6K6 | G | |
| | 6L6 | G | |
| | 6U6 | G | |
| | 6V6 | G | |
| | 6Y6 | G | |

| | |
|---|---|
| No. 1 on loctal | to No. 2 on octal |
| 2 | to 3 |
| 3 | to 4 |
| 6 | to 5 |
| 7 | to 8 |
| 8 | to 7 |

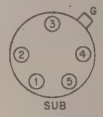
| | | | |
|---|---|---|---|
| | 7B5 | G | Parallel circuits only. No changes. |
| | 7C5 | G | |
| 7A6 | 6H6 | E | Reverse 6H6 to 7A6 procedure. |
| | 5679 | E | No changes. Do not use unused terminals for anchor. |
| 7A7 | 6C6 | G | Reverse 6C6 to 7A7 procedure. |
| | 6D6 | E | |
| | 77 | G | |
| | 78 | E | |
| | 6D7 | G | Change socket to seven prong and rewire as follows: |
| | 6E7 | G | |

| | |
|---|---|
| No. 1 on loctal | to No. 1 on seven prong |
| 2 | to 2 |
| 3 | to 3 |
| 4 | to 4 |
| 6 | to cap |
| 7 | to 6 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| | 6J7 | G | Reverse 6K7 to 7A7 procedure |
| | 6K7 | E | |
| | 6S7 | G | Parallel circuits only. Reverse 6K7 to 7A7 procedure. |
| | 6SH7 | G | Reverse 12SJ7 to 7B7 procedure. |
| | 6SJ7 | G | |
| | 6SK7 | E | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 7A7 | 6SS7 | G | Parallel circuits only. Reverse 12SJ7 to 7B7 procedure. |
| | 6U7 | G | Reverse to 6K7 to 7A7 procedure. |
| | 6W7 | G | Parallel circuits only. Reverse to 6K7 to 7A7 procedure. |
| | 7B7 | G | Parallel circuits only. No changes. |
| | 7C7 | G | |
| | 7H7 | G | No changes. |
| | 7L7 | G | |
| | 39/44 | E | Change socket to five prong and rewire as follows: |

| No. 1 on loctal | to No. | 1 on five prong |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 3 |
| 4 | to | 4 |
| 6 | to | cap |
| 7 | to | 4 |
| 8 | to | 5 |




| | | | |
|---|---|---|---|
| 7A8 | 6A7 | E | Parallel circuits only. Reverse 6A7 to 7B8 procedure. |
| | 6A8 | E | Parallel circuits only. Reverse 6D8 to 7A8 procedure. |
| | 6D8 | G | Reverse 6D8 to 7A8 procedure. |
| | 7B8 | E | Parallel circuits only. No changes. |
| | 7J8 | G | |
| | 7S7 | G | |
| | 7Q7 | G | Parallel circuits only. Remove and tape up wires on No. 5. Connect Nos. 5 and 8 together. |
| | 12A8 | P | Series circuits only. Reverse 12A8 to 14B8 procedure. |
| | 14B8 | P | Series circuits only. No changes. |
| | 14J7 | P | |
| | 14S7 | P | |
| 7AB7 | 7AD7 | P | Same as 7AB7 to 7AG7. Parallel circuits only. |
| | 7AJ7 | P | |
| | 7AK7 | P | |
| | 7G7 | P | |
| | 7H7 | P | |
| | 7L7 | P | |
| | 7T7 | P | |
| | 7V7 | P | |
| | 7AG7 | G | Rewire as follows: |
| | 7AH7 | G | |
| | 7B7 | G | |
| | 7C7 | G | |

Remove wires from No. 1
No. 2 to No. 1
3 to 2
Connect wires removed from No. 1 to No. 3
Remove wires from No. 8
No. 7 to No. 8
6 to 7
5 to 6
Connect wires removed from No. 8 to No. 7
Connect No. 4 and No. 7 together.

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 7AB7 | 1204 | E | No changes. |
| 7AD7 | 7AG7 | P | Parallel circuits only. No changes. |
| | 7AH7 | P | |
| | 7AJ7 | P | |
| | 7AK7 | P | |
| | 7B7 | P | |
| | 7C7 | P | |
| | 7G7 | P | |
| | 7H7 | P | |
| | 7L7 | P | |
| | 7T7 | P | |
| | 7V7 | P | |
| 7AF7 | 7F7 | G | No changes. |
| | 7N7 | G | Parallel circuits only. No changes. |
| 7AG7 | 7AH7 | G | No changes. |
| | 7B7 | P | |
| | 7C7 | P | |
| | 7AJ7 | P | Parallel circuits only. No changes. |
| | 7AK7 | P | |
| | 7G7 | G | |
| | 7H7 | G | |
| | 7L7 | G | |
| | 7T7 | G | |
| | 7V7 | G | |
| 7AH7 | 7AG7 | G | No changes. |
| | 7B7 | P | |
| | 7C7 | P | |
| | 7AJ7 | G | Parallel circuits only. No changes. |
| | 7AK7 | P | |
| | 7G7 | P | |
| | 7H7 | P | |
| | 7L7 | P | |
| | 7T7 | P | |
| | 7V7 | P | |
| 7AJ7 | 7AH7 | G | Parallel circuits only. No changes. |
| | 7AK7 | P | |
| | 7B7 | P | |
| | 7C7 | P | |
| | 7G7 | P | |
| | 7V7 | P | |
| | 7H7 | P | No changes. |
| | 7L7 | P | |
| | 7T7 | P | |
| 7AK7 | 7AH7 | P | Parallel circuits only. No changes. |
| | 7AJ7 | P | |
| | 7B7 | P | |
| | 7C7 | P | |
| | 7G7 | P | |
| | 7H7 | P | |
| | 7L7 | P | |
| | 7T7 | P | |
| | 7V7 | P | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 7B4 | 6AD5 | G | Reverse 6J5 to 7A4 procedure. |
| | 6AE5 | G | |
| | 6F5 | G | Change socket to octal and rewire as follows. |

| No. 1 on loctal | to No. 2 on octal |
|---|---|
| 2 | to 4 |
| 6 | to cap |
| 7 | to 8 |
| 8 | to 7 |

| | | | |
|---|---|---|---|
| | 6J5 | G | Reverse 6J5 to 7A4 procedure. |
| | 6K5 | G | Reverse 6K5 to 7B4 procedure. |
| | 6P5 | G | Reverse 6J5 to 7A4 procedure. |
| | 7A4 | G | No changes. |
| | XXL | G | |
| 7B5 | 6AD7 | G | Parallel circuits only. Reverse 6K6 to 7B5 procedure. Remove and tape up any wires anchored on unused pins. |
| | 6F6 | G | Parallel circuits only. Reverse 6K6 to 7B5 procedure. |
| | 6K6 | E | Reverse 6K6 to 7C5 procedure. |
| | 6L6 | G | Parallel circuits only. Reverse 6K6 to 7B5 procedure. |
| | 6U6 | G | |
| | 6V6 | G | |
| | 6Y6 | G | |
| | 7A5 | G | Parallel circuits only. No changes. |
| | 7C5 | G | |
| | 41 | G | Change socket to six prong and rewire as follows: |
| | 42 | E | |

| No. 1 on loctal | to No. 1 on six prong |
|---|---|
| 2 | to 2 |
| 3 | to 3 |
| 6 | to 4 |
| 7 | to 5 |
| 8 | to 6 |

| | | | |
|---|---|---|---|
| 7B6 | 6B6 | E | Reverse 6B6 to 7B6 procedure. |
| | 6Q7 | E | Reverse 6Q7 to 7B6 procedure. |
| | 6R7 | G | |
| | 6SQ7 | E | Reverse 6SQ7 to 7B6 procedure. |
| | 6T7 | G | Parallel circuits only. Reverse 6Q7 to 7B6 procedure. |
| | 7C6 | G | Parallel circuits only. No changes. |
| | 7E6 | G | No changes. |
| | 75 | E | Reverse 75 to 7E6 procedure. |
| | 85 | G | Reverse 75 to 7E6 procedure. |
| 7B7 | 6C6 | G | Parallel circuits only. Reverse 6C6 to 7A7 procedure. |
| | 6D6 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 7B7 | 6D7 | G | Same as 7A7 to 6D7. Parallel circuits only. |
| | 6E7 | G | |
| | 6J7 | G | Parallel circuits only. Reverse 6J7 to 7L7 procedure. |
| | 6K7 | G | Parallel circuits only. Reverse 6K7 to 7A7 procedure. |
| | 6S7 | G | Reverse 6K7 to 7A7 procedure. |
| | 6SH7 | G | Parallel circuits only. Reverse 12SJ7 to 7B7 procedure. |
| | 6SJ7 | G | |
| | 6SK7 | G | |
| | 6SS7 | G | Reverse 12SJ7 to 7B7 procedure. |
| | 6U7 | G | Parallel circuits only. Reverse 6K7 to 7A7 procedure. |
| | 6W7 | G | Reverse 6K7 to 7A7 procedure. |
| | 7A7 | G | Parallel circuits only. No changes. |
| | 7C7 | G | No changes. |
| | 7H7 | G | Parallel circuits only. No changes. |
| | 12J7 | P | Series circuits only. Reverse 6K7 to 7A7 procedure. |
| | 12K7 | P | |
| | 12SG7 | P | Series circuits only. Reverse 12SJ7 to 7B7 procedure. |
| | 12SH7 | P | |
| | 12SJ7 | P | |
| | 12SK7 | P | |
| | 14A7/12B7 | P | Series circuits only. No changes. |
| | 39/44 | G | Same as 7A7 to 39/44. Parallel circuits only. |
| | 77 | G | Parallel circuits only. Reverse 6C6 to 7A7 procedure. |
| | 78 | G | |
| 7B8 | 6A7 | G | Reverse 6A7 to 7B8 procedure. |
| | 6A8 | G | Reverse as 12A8 to 14B8 procedure. |
| | 6D8 | G | Parallel circuits only. Reverse 12A8 to 14B8 procedure. |
| | 6J8 | E | Reverse 12A8 to 14B8 procedure. |
| | 6K8 | E | |
| | 7A8 | G | Parallel circuits only. No changes. |
| | 7J7 | G | No changes. |
| | 7S7 | G | No changes. |
| 7C4 | 1203A | E | No changes. |
| | 9006 | G | Change socket to miniature and rewire as follows: |

| No. 1 on loctal | to No. 3 on miniature |
|---|---|
| 4 | to 1 |
| 7 | to 7 |
| 8 | to 4 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 7C5 | 6AD7 | G | Parallel circuits only. Reverse 6K6 to 7B5 procedure. Do not anchor on unused pins. |
| | 6F6 | G | Parallel circuits only. Reverse 6K6 to 7B5 procedure. |
| | 6G6 | G | |
| | 6K6 | G | |
| | 6L6 | G | |
| | 6U6 | G | |
| | 6V6 | E | |
| | 6Y6 | G | |
| | 7A5 | G | Parallel circuits only. No changes. |
| | 7B5 | G | Parallel circuits only. No changes. |
| | 41 | G | Same as 7B5 to 41. Parallel circuits only. |
| | 42 | G | |
| 7C6 | 6B6 | G | Parallel circuits only. Reverse 6Q7 to 7B6 procedure. |
| | 6Q7 | G | |
| | 6R7 | G | |
| | 6SQ7 | G | Parallel circuits only. Reverse 6SQ7 to 7B6 procedure. |
| | 6ST7 | G | Reverse 6SQ7 to 7B6 procedure. |
| | 6T7 | G | |
| | 7B6 | G | Parallel circuits only. No changes. |
| | 12Q7 | P | Series circuits only. Reverse 6Q7 to 7B6 procedure. |
| | 12SQ7 | P | Series circuits only. Reverse 6SQ7 to 7B6 procedure. |
| | 12SR7 | P | |
| | 14B6 | P | Series circuits only. No changes. |
| | 14E6 | P | |
| | 75 | G | Parallel circuits only. Reverse 75 to 7E6 procedure. |
| | 85 | G | |
| 7C7 | 6C6 | G | Parallel circuits only. Reverse 6C6 to 7A7 procedure. |
| | 6D6 | G | |
| | 77 | G | |
| | 78 | G | |
| | 6D7 | G | Same as 7A7 to 6D7. Parallel circuits only. |
| | 6E7 | G | |
| | 6S7 | G | Reverse 6K7 to 7A7 procedure. |
| | 6SS7 | G | Reverse 12SJ7 to 7B7 procedure. |
| | 6W7 | G | Reverse 6K7 to 7A7 procedure. |
| | 7A7 | G | Parallel circuits only. No changes. |
| | 7B7 | G | No changes. |
| | 7H7 | G | Parallel circuits only. No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 7C7 | 12J7 | P | Series circuits only. Reverse 6K7 to 7A7 procedure. |
| | 12K7 | P | |
| | 12SG7 | P | Series circuits only. Reverse 12SJ7 to 7B7 procedure. |
| | 12SH7 | P | |
| | 12SJ7 | P | |
| | 12SK7 | P | |
| | 14A7/12B7 | P | Series circuits only. No changes. |
| | 36 | G | Same as 7A7 to 39/44. Parallel circuits only. |
| | 39/44 | G | |
| 7D7 | | | No practical substitute. |
| 7E5 | 7A4 | P | Parallel circuits only. Rewire as follows: |
| | 7B4 | P | Remove wires from No. 1<br>No. 2 to No. 1<br>3 and 7 to 2<br>4 and 6 to 7<br>5 to 6<br>Connect wires removed from No. 1 to No. 6 |
| | 1201 | E | No changes. |
| 7E6 | 6B6 | G | Reverse 6Q7 to 7B6 procedure. |
| | 6Q7 | G | |
| | 6R7 | G | Reverse 6Q7 to 7B6 procedure. |
| | 6SQ7 | G | Reverse 6SQ7 to 7B6 procedure. |
| | 6SR7 | G | Reverse 6SQ7 to 7B6 procedure. |
| | 6T7 | G | Parallel circuits only. Reverse 6Q7 to 7B6 procedure. |
| | 75 | G | Reverse 75 to 7E6 procedure. |
| | 85 | G | Reverse 75 to 7E6 procedure. |
| | 7B6 | G | No changes. |
| | 7C6 | G | Parallel circuits only. No changes. |
| 7E7 | 6B8 | G | Reverse 6B8 to 7E7 procedure. |
| | 7R7 | G | No changes. |
| 7F7 | 6C8 | G | Reverse 6C8 to 7F7 procedure. |
| | 6F8 | G | Parallel circuits only. Reverse 6C8 to 7F7 procedure. |
| | 6SC7 | G | Reverse 6SC7 to 7F7 procedure. |
| | 6SL7 | G | Reverse 6SL7 to 7F7 procedure. |
| | 7AF7 | G | No changes. |
| | 7F8 | G | Reverse 7F8 to 7F7 procedure. |
| | 7N7 | G | Parallel circuits only. No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 7F8 | 2C51 | P | Reverse 2C51 to 7F8 procedure. |
| | 6F8 | P | Parallel circuits only. Change socket to octal and rewire as follows:<br>No. 1 on loctal to cap on octal<br>2 to 2<br>3 to 3<br>4 to 4<br>5 to 8<br>6 to 6<br>7 to 7<br>8 to 5<br> <br> |
| | 7AF7 | P | Same as 7F8 to 7F7. |
| | 7F7 | P | Rewire as follows:<br>Remove wires from No. 1<br>No. 2 to No. 1<br>4 to 2<br>Connect wires removed from No. 1 to No. 4<br>Remove wires from No. 8<br>No. 7 to No. 8<br>5 to 7<br>Connect wires removed from No. 8 to No. 5 |
| | 7N7 | P | Same as 7F8 to 7F7. Parallel circuits only. |
| | 5670 | E | Parallel circuits only. Reverse 2C51 to 7F8 procedure. |
| 7G7 | 7A7 | G | Parallel circuits only. No changes. |
| | 7B7 | G | |
| | 7C7 | G | |
| | 7H7 | G | |
| | 7L7 | G | |
| | 7V7 | G | No changes. |
| | 1232 | G | Parallel circuits only. No changes. |
| 7G7/1232 | 6J7 | G | Parallel circuits only. Reverse 6J7 procedure. |
| | 6K7 | G | |
| | 6U7 | G | |
| 7H7 | 7A7 | G | No changes. |
| | 7B7 | G | Parallel circuits only. No changes. |
| | 7C7 | G | |
| | 7L7 | G | No changes. |
| | 7T7 | G | |
| | 7V7 | G | Parallel circuits only. No changes. |
| | 1231 | G | |
| | 1273 | G | No changes. |
| 7J7 | 6A8 | E | Reverse 6J8 to 7J7 procedure. |
| | 6J8 | E | |
| | 6K8 | E | |
| | 7B8 | G | No changes. |
| | 7S7 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 7K7 | 7B6 | G | Rewire as follows: |
| | 7E6 | G | No. 2 to No. 7<br>3 to 2<br>4 to 3 |
| | 7X7 | G | Rewire as follows:<br>Remove wires from No. 2<br>No. 3 to No. 2<br>4 to 3<br>Connect wires removed from No. 2 to No. 4 |
| 7L7 | 6J7 | G | Reverse 6J7 to 7L7 procedure. |
| | 6K7 | G | Reverse 6K7 to 7A7 procedure. |
| | 7A7 | G | No changes. |
| | 7G7 | G | Parallel circuits only. No changes. |
| | 7H7 | G | No changes. |
| | 7T7 | G | No changes. |
| | 7V7 | G | Parallel circuits only. No changes. |
| 7N7 | 6C8 | G | Parallel circuits only. Reverse 6C8 to 7F7 procedure. |
| | 6F8 | G | Reverse 6C8 to 7F7 procedure. |
| | 7AF7 | G | Parallel circuits only. No changes. |
| | 7F7 | G | Parallel circuits only. No changes. |
| 7Q7 | 6SA7 | G | Reverse 12SA7 to 14Q7 procedure. |
| 7R7 | 7E7 | G | No changes. |
| 7S7 | 6A7 | G | Reverse 6A7 to 7B8 procedure. |
| | 6A8 | G | |
| | 6J8 | G | Reverse 6J8 to 7J7 procedure. |
| | 6K8 | G | |
| | 7B8 | G | No changes. |
| | 7J7 | G | |
| 7T7 | 7A7 | G | No changes. |
| | 7B7 | G | Parallel circuits only. No changes. |
| | 7C7 | G | Parallel circuits only. No changes. |
| | 7G7 | G | Parallel circuits only. No changes. |
| | 7H7 | G | No changes. |
| | 7L7 | G | No changes. |
| | 7V7 | G | No changes. |
| | 1231 | G | Parallel circuits only. No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 7T7 | 1273 | G | No changes. |
| 7V7 | 7B7 | G | Parallel circuits only. No changes. |
| | 7C7 | G | |
| | 7G7 | G | No changes. |
| | 1232 | G | |
| | 7W7 | E | Rewire as follows:<br>No. 4 to No. 5<br>Do not use No. 4 for anchor |
| 7W7 | 7V7 | E | Rewire as follows:<br>No. 4 to No. 7<br>5 to 4 |
| 7X6 | 7Y4 | G | Parallel circuits only. Rewire as follows:<br>Connect Nos. 2 and 7 together.<br>Cannot be used where 7X6 is employed as a doubler. |
| | 7Z4 | G | |
| 7X7 | 7K7 | G | Rewire as follows:<br>Remove wires from No. 2<br>No. 4 to No. 2<br>3 to 4<br>Connect wires removed from No. 2 to No. 3 |
| | XXFM | E | No changes. |
| 7Y4 | 6X5 | E | Reverse 6X5 to 7Y4 procedure. |
| | 7X6 | G | Parallel circuits only. No changes.<br>If it is convenient, connect No. 2 and 7 together. |
| | 7Z4 | G | Parallel circuits only. No changes. |
| 7Z4 | 6W5 | G | Parallel circuits only. Reverse 6X5 to 7Y4 procedure. |
| | 6X5 | E | |
| | 6ZY5 | G | |
| | 7X6 | G | No changes. If it is convenient, connect Nos. 2 and 7 together. |
| | 7Y4 | G | Parallel circuits only. No changes. |
| 10 | 10Y | E | No changes |
| | RK10 | E | |
| | 50 | G | |
| | 210 | E | |
| | 310 | E | |
| 10Y | 10 | E | No changes. |
| | RK10 | E | |
| | 50 | G | |
| | 210 | E | |
| | 310 | E | |
| 12A | 71A | G | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 12A5 | 12A6 | G | 12 volt operation only. Parallel circuits only. Change socket to octal and rewire as follows: |

| | | |
|---|---|---|
| No. 1 on seven prong | to No. | 2 on octal |
| 2 | to | 3 |
| 3 | to | 4 |
| 4 | to | 5 |
| 5 | to | 8 |
| 7 | to | 7 |

| | | | |
|---|---|---|---|
| 12A6 | 6G6 | P | No changes. Series circuits. |
| | 14A5 | G | Same as 35L6 to 35A5. |
| 12A8 | 12K8 | G | No changes. |
| | 14A7/12B7 | P | Change socket to loctal and rewire as follows: |

| | | |
|---|---|---|
| No. 2 on octal | to No. | 1 on loctal |
| 3 | to | 2 |
| 5 | to | 6 |
| 6 | to | 3 |
| 7 | to | 8 |
| 8 | to | 7 |
| cap | to | 4 |

Must be well shielded. Realign if necessary

| | | | |
|---|---|---|---|
| | 14B8 | G | Change socket to loctal and rewire as follows: |
| | 14J7 | G | |
| | 14S7 | G | |

| | | |
|---|---|---|
| No. 2 on octal | to No. | 1 on loctal |
| 3 | to | 2 |
| 4 | to | 5 |
| 5 | to | 4 |
| 6 | to | 3 |
| 7 | to | 8 |
| 8 | to | 7 |
| cap | to | 6 |

| | | | |
|---|---|---|---|
| 12AH7 | 12AT7 | G | Change socket to noval and rewire as follows: |

| | | |
|---|---|---|
| No. 1 on octal | to No. | 2 on noval |
| 2 | to | 3 |
| 3 | to | 1 |
| 4 | to | 8 |
| 5 | to | 7 |
| 6 | to | 6 |
| 7 | to | 5 |
| 8 | to | 4 |

| | | | |
|---|---|---|---|
| | 14AF7/XXD | G | Change socket to loctal and rewire as follows: |
| | 14F7 | G | |

| | | |
|---|---|---|
| No. 1 on octal | to No. | 4 on loctal |
| 2 | to | 2 |
| 3 | to | 3 |
| 4 | to | 7 |
| 5 | to | 5 |
| 6 | to | 6 |
| 7 | to | 8 |
| 8 | to | 1 |

| | | | |
|---|---|---|---|
| 12AL5 | 12H6 | G | Where space permits. Same as 6AL5 to 6H6. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 12AT6 | 12AV6 | G | No changes. |
| | 12BF6 | P | |
| | 12BK6 | G | |
| | 12BT6 | P | |
| | 12BU6 | P | |
| | 12SQ7 | G | Where space permits. Reverse 12SQ7 to 12AT6 procedure. |
| | 12SR7 | P | |
| | 12SW7 | P | |
| 12AT7* | 12AH7 | G | Where space permits. Reverse 12AH7 to 12AT7 procedure. |
| | 12AU7 | G | No changes. |
| | 12AV7 | G | Parallel circuits only. No changes. |
| | 12AX7 | G | No changes. |
| | 12AY7 | G | |
| | 12BH7 | G | Parallel circuits only. No changes. |
| 12AU6 | 12AW6 | G | Reverse Nos. 2 and 7. |
| | 12BA6 | G | No changes. |
| | 12BD6 | G | |
| 12AU7* | 12AT7 | G | No changes. |
| | 12AV7 | G | Parallel circuits only. No changes. |
| | 12AX7 | G | No changes. |
| | 12AY7 | G | |
| 12AV6 | 12AT6 | G | No changes. |
| | 12BF6 | P | |
| | 12BK6 | G | |
| | 12BT6 | G | |
| | 12BU6 | G | |
| 12AV7 | 12AT7 | G | Parallel circuits only. No changes. |
| | 12AU7 | G | |
| | 12AX7 | G | |
| | 12AY7 | G | |
| | 12BH7 | G | |
| 12AW6 | 12AU6 | G | Rewire as follows: |
| | 12BA6 | G | Reverse No. 2 and No. 7 |
| 12AX7 | 12AT7 | G | No changes. |
| | 12AU7 | G | |
| | 12AV7 | G | Parallel circuits only. No changes. |
| | 12AY7 | G | No changes. |
| | 12BH7 | G | Parallel circuits only. No changes. |
| 12AY7 | 12AT7 | G | No changes. |
| | 12AU7 | G | |
| | 12AV7 | G | Parallel circuits only. No changes. |

* See Addendum at back of this section.

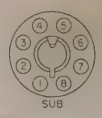
| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 12AY7 | 12AX7 | G | No changes. |
| | 12BH7 | G | Parallel circuits only. No changes. |
| 12B6M | | | No practical substitute. |
| 12B7 | 14A7 | E | No changes. |
| 12B8GT | | | No practical substitute. |
| 12BA6 | 12AU6 | G | No changes. |
| | 12AV6 | G | Reverse 12AW6 to 12AU6 procedure. |
| | 12AW6 | G | |
| 12BA7 | 12BE6 | G | Change socket to miniature and rewire as follows: |

| No. 1 on noval | to No. | 6 on miniature |
|---|---|---|
| 2 | to | 1 |
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | 4 |
| 6 | to | 2 |
| 7 | to | 7 |
| 9 | to | 5 |

| | | | |
|---|---|---|---|
| 12BD6 | 12AU6 | G | No changes. |
| | 12AW6 | G | Rewire as follows: Reverse No. 7 and No. 2 |
| | 12BA6 | G | No changes. |
| 12BE6 | 12BA7 | G | Same as 6BE6 to 6BA7. |
| | 12SA7 | G | Where space permits. Reverse 12SA7 to 12BE6 procedure. |
| 12BF6 | 12AT6 | P | No changes. |
| | 12AV6 | P | |
| | 12BK6 | P | |
| | 12BT6 | P | |
| | 12BU6 | G | |
| 12BH7 | 12AT7 | G | Parallel circuits only. No changes. |
| | 12AU7 | G | |
| | 12AV7 | G | |
| | 12AX7 | G | |
| | 12AY7 | G | |
| 12BK6 | 12AT6 | G | No changes. |
| | 12AV6 | G | |
| | 12BF6 | P | |
| | 12BT6 | G | |
| | 12BU6 | G | |
| 12BT6 | 12AT6 | G | No changes. |
| | 12AV6 | G | |
| | 12BF6 | P | |
| | 12BK6 | G | |
| | 12BU6 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 12BU6 | 12AT6 | P | No changes. |
| | 12AV6 | P | |
| | 12BF6 | G | |
| | 12BK6 | P | |
| | 12BT6 | P | |
| 12C8 | 14E7 | G | Change socket to loctal and rewire as follows: |
| | 14R7 | G | |

| No. 2 on octal | to No. | 1 on loctal |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | 4 |
| 6 | to | 5 |
| 7 | to | 8 |
| 8 | to | 7 |
| cap | to | 6 |




| | | | |
|---|---|---|---|
| 12E5 | 1626 | G | Parallel circuits only. No changes. |
| 12F5 | 12J5 | G | Rewire as follows: No. 4 to No. 3. Connect grid wire to No. 5. |
| | 12SF5 | E | Same as 6F5 to 6SF5. |
| 12G7G | | | No practical substitute. |
| 12H6 | 12AL5 | E | Change socket to miniature and rewire as follows: |

| No. 2 on octal | to No. | 3 on miniature |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 5 |
| 5 | to | 7 |
| 7 | to | 4 |
| 8 | to | 1 |

| | | | |
|---|---|---|---|
| 12J5 | 12F5 | G | Rewire as follows: No. 3 to No. 4. Connect wire from No. 5 to grid cap. |
| | 12SF5 | G | Same as 12SF5 to 12J5. |
| | 14A4 | G | Same as 6J5 to 7A4. |
| | 1626 | G | Parallel circuits only. No changes. |
| 12J7 | 6S7 | P | Series circuits only. No changes. |
| | 6W7 | P | |
| | 7B7 | P | Same as 12K7 to 7B7 but in series circuits only. |
| | 7C7 | P | |
| | 12B7 | E | |
| | 12K7 | G | No changes. |
| | 12SG7 | G | Same as 12K7 to 12SK7. |
| | 12SH7 | G | |
| | 12SJ7 | E | |
| | 12SK7 | G | |
| | 14A7 | E | Same as 12K7 to 7B7 but in series circuits only. |
| 12K7 | 6S7 | P | Series circuits only. No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 12K7 | 6SS7 | G | Same as 12K7 to 12SK7. Series circuits only. |
| | 6W7 | E | Series circuits only. No changes. |
| | 7B7 | P | Change socket to loctal and rewire as follows, series circuits only: |
| | 7C7 | P | |
| | 12B7 | E | |
| | 14A7 | E | |
| | 14C7 | E | |

| No. 1 on octal | to No. 5 on loctal |
|---|---|
| 2 | 1 |
| 3 | 2 |
| 4 | 3 |
| 5 | 4 |
| 7 | 8 |
| 8 | 7 |
| cap | 6 |

| | | | |
|---|---|---|---|
| | 12J7 | G | No changes. |
| | 12SK7 | E | Make adaptor as follows: |

| No. 1 on base | to No. 1 on top |
|---|---|
| 2 | 2 |
| 3 | 8 |
| 4 | 6 |
| 5 | 3 |
| 7 | 7 |
| 8 | 5 |
| cap | 4 |

| | | | |
|---|---|---|---|
| 12K8 | 12A8 | G | No changes. |
| | 14B8 | G | Same as 12A8 to 14B8. |
| | 14J7 | G | |
| | 14S7 | G | |
| 12L8 | 1644 | G | No changes. |
| 12Q7 | 6ST7 | P | Same as 12Q7 to 12SQ7. Series circuits only. |
| | 6T7 | P | Series circuits only. No changes. |
| | 7C6 | P | Series circuits only. Same as 6Q7 to 7B6. |
| | 14B6 | E | |
| | 14E6 | G | |
| | 12SQ7 | E | Make adaptor as follows: |

| No. 1 on base | to No. 1 on top |
|---|---|
| 2 | 8 |
| 3 | 6 |
| 4 | 4 |
| 5 | 5 |
| 7 | 7 |
| 8 | 3 |

| | | | |
|---|---|---|---|
| 12SA7 | 6SS7 | P | Same as 12SA7 to 12SK7 series circuits. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 12SA7 | 7A8 | P | Series circuits only. Change socket to loctal and rewire as follows: |

No. 1 on octal to shield connection on loctal socket

| | | |
|---|---|---|
| 2 | to | No. 1 |
| 3 | to | 2 |
| 4 | to | 5 |
| 5 | to | 4 |
| 6 | to | 7 |
| 7 | to | 8 |
| 8 | to | 6 |

The 7A8 heats faster than the other tubes and a 200 ohm 1/2 watt resistor must be connected across the filament terminals 2 and 7 or its life will be very short.

| | | |
|---|---|---|
| | 7B7 | P |
| | 7C7 | P |
| | 12B7/14A7 | P |

Series circuits only. Change socket to loctal and rewire as follows:

| No. 2 on octal | | to No. 1 on loctal |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | 6 |
| 6 | to | 7 |
| 7 | to | 8 |
| 8 | to | 4 |

| | | |
|---|---|---|
| | 12BE6 | G |

Change socket to miniature and rewire as follows:

| No. 2 on octal | | to No. 3 on miniature |
|---|---|---|
| 3 | to | 5 |
| 4 | to | 6 |
| 5 | to | 1 |
| 6 | to | 2 |
| 7 | to | 4 |
| 8 | to | 7 |

| | | |
|---|---|---|
| | 12J7 | P |
| | 12K7 | P |

Make adaptor as follows:

| No. 1 on base | | to No. 1 on top |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 3 |
| 4 | to | 4 |
| 5 | to | cap |
| 6 | to | 8 |
| 8 | to | 5 |

| | | |
|---|---|---|
| | 12SJ7 | P |
| | 12SK7 | P |

Change connections as follows:

Reverse Nos. 8 and 3
Remove wire from No. 6
Move wire from No. 4 to 6
from 5 to 4
from 6 to 5

This uses suppresor grid as control grid and control as oscillator grid.

| | | |
|---|---|---|
| | 14Q7 | G |

Change socket to loctal and rewire as follows:

| No. 2 on octal | | to No. 1 on loctal |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | 4 |
| 6 | to | 7 and 5 |
| 7 | to | 8 |
| 8 | to | 6 |

| | | | |
|---|---|---|---|
| 12SC7 | 12SL7 | G | Same as 6SC7 to 6SL7. |
| | 1634 | G | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 12SF5 | 12F5 | G | Reverse 6F5 to 6SF5 procedure. |
| | 12J5 | G | Rewire as follows:<br>Reverse No. 2 and No. 8<br>Reverse No. 3 and No. 5 |
| 12SF7 | 12SK7 and Germanium Diode | P | Rewire as follows:<br>Move wire from No. 2 to No. 4<br>6 to 8<br>8 to 2<br>4 to 6<br>Remove wires from No. 5<br>Connect No. 3 and No. 5 together<br>Diode crystal from No. 3 or 5 to wires removed from No. 3 |
| 12SG7 | 12AU6<br>12BA6<br>12BD6 | G<br>G<br>G | Change socket to miniature and rewire as follows:<br>No. 2 on octal to No. 3 on miniature<br>3 to 7<br>4 to 1<br>5 to 7<br>6 to 6<br>7 to 4<br>8 to 5<br> <br> |
| | 12SH7<br>12SJ7<br>12SK7 | G<br>G<br>G | No changes. |
| 12SH7 | 12AU6<br>12BA6<br>12BD6 | G<br>G<br>G | Same as 12SG7 to 12BA6. |
| | 12SG7<br>12SJ7<br>12SK7 | G<br>G<br>G | No changes. |
| 12SJ7 | 6S7<br>6W7 | P<br>P | Same as 12SK7 to 12K7. Series circuits only. |
| | 12B7<br>14A7<br>14C7 | G<br>G<br>G | Change socket to loctal and rewire as follows:<br>No. 2 on octal to No. 1 on loctal<br>3 to 4<br>4 to 6<br>5 to 7<br>6 to 3<br>7 to 8<br>8 to 2<br> <br> |
| | 12J7<br>12K7 | G<br>G | Same as 12SK7 to 12K7. |
| 12SK7 | 6S7<br>6W7 | P<br>P | Same as 12SK7 to 12K7. Series circuits only. |
| | 6SS7 | P | No changes. Series circuits only. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 12SK7 | 12AU6 | G | Change socket to miniature and rewire as follows: |
| | 12BA6 | G | |
| | 12BD6 | G | |

| No. 2 on octal | to No. | 3 on miniature |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 1 |
| 5 | to | 7 |
| 6 | to | 6 |
| 7 | to | 4 |
| 8 | to | 5 |

| | | | |
|---|---|---|---|
| | 12B7 | E | Change socket to loctal and rewire as follows: |
| | 14A7 | E | |
| | 14C7 | G | |

| No. 1 on octal | to No. | 5 on loctal |
|---|---|---|
| 2 | to | 1 |
| 3 | to | 4 |
| 4 | to | 6 |
| 5 | to | 7 |
| 6 | to | 3 |
| 7 | to | 8 |
| 8 | to | 2 |

| | | | |
|---|---|---|---|
| | 12J7 | G | Make adaptor as follows: |
| | 12K7 | E | |

| No. 1 on base | to No. | 1 on top |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 5 |
| 4 | to | cap |
| 5 | to | 8 |
| 6 | to | 4 |
| 7 | to | 7 |
| 8 | to | 3 |

| | | | |
|---|---|---|---|
| | 12SG7 | G | No changes. |
| | 12SH7 | G | |
| | 12SJ7 | G | |
| 12SL7 | 12SC7 | G | Reverse 6SC7 to 6SL7 procedure. If the 12SL7 employs the two cathodes separately this substitution may be impractical. |
| 12SN7 | 12SL7 | P | Parallel circuits only. No changes. |
| | 12SX7 | G | No changes. |
| 12SQ7 | 6ST7 | P | Series circuits. No changes. |
| | 6T7 | P | Same as 12SQ7 to 12Q7. Series circuits only. |
| | 7C6 | P | Same as 12SQ7 to 14B6. Series circuits only. |
| | 12AT6 | G | Change socket to miniature and rewire as follows: |
| | 12AV6 | G | |
| | 12BK6 | G | |
| | 12BT6 | G | |
| | 12BU6 | P | |

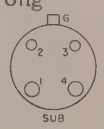
| No. 2 on octal | to No. | 1 on miniature |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 5 |
| 5 | to | 6 |
| 6 | to | 7 |
| 7 | to | 3 |
| 8 | to | 4 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 12SQ7 | 12Q7 | E | Make adaptor as follows: |
| | | | No. 1 on base to No. 1 on top cap |
| | | | 2 to 8 |
| | | | 3 to 4 |
| | | | 4 to 5 |
| | | | 5 to 3 |
| | | | 6 to 7 |
| | | | 7 to 2 |
| | | | 8 |
| | 12SR7 | G | No changes. |
| | 12SW7 | P | No changes. |
| | 14B6 | E | Change socket to loctal and rewire as follows: |
| | 14E6 | G | No. 2 on octal to No. 3 on loctal |
| | | | 3 to 7 |
| | | | 4 to 5 |
| | | | 5 to 6 |
| | | | 6 to 2 |
| | | | 7 to 8 |
| | | | 8 to 1 |
| 12SR7 | 12AT6 | P | Same as 12SQ7 to 12AT6. |
| | 12AV6 | P | |
| | 12BK6 | P | |
| | 12BT6 | P | |
| | 12BU6 | G | |
| | 12Q7 | G | Same as 12SQ7 to 12Q7. |
| | 12SQ7 | G | No changes. |
| | 12SW7 | G | No changes. |
| | 14B6 | G | Same as 12SQ7 to 14B6. |
| | 14E6 | G | |
| 12SW7 | 12AT6 | P | Same as 12SQ7 to 12AT6. |
| | 12AV6 | P | |
| | 12BK6 | P | |
| | 12BT6 | P | |
| | 12BU6 | G | |
| | 12SQ7 | P | No changes. |
| | 12SR7 | G | |
| 12SX7 | 12SL7 | P | Parallel circuits only. No changes. |
| | 12SN7 | G | No changes. |
| 12SY7 | 12SA7 | G | No changes. |
| | 14Q7 | G | Same as 12SA7 to 14Q7. |
| 12Z3 | 1V | G | Series Circuits only. No changes. |
| 12Z5 | | | No practical substitute. |
| 14A4 | 12J5 | E | Reverse 6J5 to 7A4 procedure. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 14A5 | 12A6 | E | Reverse 35L6 to 35A5 procedure. |
| | 1284 | P | No changes. Connect No. 4 to No. 7 for best results. |
| 14A7/12B7 | 6S7 | P | Reverse 12K7 to 7B7 procedure. Series circuits only. |
| | 6W7 | P | |
| | 6SS7 | P | Reverse 12SJ7 to 7B7 procedure. Series circuits only. |
| | 7B7 | P | Series circuits only. No changes. |
| | 7C7 | P | |
| | 12B7 | E | No changes. |
| | 14C7 | G | |
| | 14H7 | G | |
| | 1280 | G | |
| | 1284 | E | |
| | 12J7 | G | Reverse 12K7 to 7B7 procedure. |
| | 12K7 | E | |
| | 12SH7 | G | Reverse 12SJ7 to 7B7 procedure. |
| | 12SJ7 | G | |
| | 12SK7 | E | |
| 14AF7/XXD | 12AH7 | G | Reverse 12AH7 to 14AF7/XXD procedure. |
| | 14F7 | G | No changes. |
| | 14N7 | G | Parallel circuits only. No changes. |
| 14B6 | 7C6 | P | Series circuits only. No changes. |
| | 12Q7 | E | Reverse 6Q7 to 7B6 procedure. |
| | 14E6 | G | No changes. |
| 14B8 | 7A8 | P | Series circuits only. No changes. |
| | 12A8 | G | Reverse 12A8 to 14B8 procedure. |
| | 14J7 | G | No changes. |
| | 14S7 | G | |
| 14C5 | 14A5 | G | Parallel circuits only. No changes. |
| 14C7 | 7B7 | P | Series circuits only. No changes. |
| | 7C7 | P | |
| | 12B7 | E | No changes. |
| | 14A7 | G | |
| | 14H7 | G | |
| | 1280 | G | |
| | 1284 | E | |
| 14E6 | 12Q7 | G | Reverse 6Q7 to 7B6 procedure. |
| | 14B6 | G | No changes. |
| 14E7 | 12C8 | G | Reverse 12C8 to 14E7 procedure. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 14E7 | 14R7 | G | No changes. |
| 14F7 | 12AH7 | G | Reverse 12AH7 to 14AF7/XXD procedure. |
| | 14AF7/XXD | G | No changes. |
| | 14F8 | G | Reverse 7F8 to 7F7 procedure. |
| 14F8 | 14F7 | G | Same as 7F8 to 7F7. |
| 14H7 | 12B7 | G | No changes. |
| | 14A7 | G | |
| | 14C7 | G | |
| | 1280 | G | |
| | 1284 | G | |
| 14J7 | 7A8 | P | Series circuits. No changes. |
| | 14B8 | G | No changes. |
| | 14S7 | G | |
| 14N7 | 14AF7/XXD | G | Parallel circuits only. No changes. |
| 14Q7 | 12SA7 | G | Reverse 12SA7 to 14Q7 procedure. |
| 14R7 | 12C8 | G | Reverse 12C8 to 14E7 procedure. |
| | 14E7 | G | No changes. |
| 14S7 | 7A8 | P | Series circuits only. No changes.<br>Put 200 or 250 ohm 1/2 watt resistor across filament terminals when substituting 7 volt for 12 volt types to compensate for faster heating. |
| | 14B8 | G | No changes. |
| | 14J7 | G | No changes. |
| 14V7 | | | No practical substitute. |
| 14W7 | 12B7 | G | No changes. |
| | 14A7 | G | |
| | 14C7 | G | |
| | 14H7 | G | |
| | 1280 | G | |
| | 1284 | G | |
| 14Y4 | | | No practical substitute. |
| 15 | 1A4 | G | Same as 15 to 1B4. Battery operation only. Parallel circuits. |
| | 1B4 | G | For battery operation only. Parallel circuits. Change socket to four prong type and rewire as follows: |

| No. | 1 on five prong | to No. | 1 on four prong |
|---|---|---|---|
| | 2 | to | 2 |
| | 3 | to | 3 |
| | 4 | to | 4 |
| | 5 | to | 4 |
| | cap | to | cap |



| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 15 | 1E5 | G | For battery operation only. Parallel circuits. Change socket to octal and rewire as follows: |

| No. 1 on five prong | to No. | 2 on octal |
|---|---|---|
| 2 | to | 3 |
| 3 | to | 4 |
| 4 | to | 7 |
| 5 | to | 7 |
| cap | to | cap |

| | | | |
|---|---|---|---|
| | 32 | G | Same as 15 to 1B4. Battery operation only. Parallel circuits. |
| | 34 | G | |
| | 951 | G | |
| 17 | | | No practical substitute. |
| 18 | | | No practical substitute. |
| 19 | 1J6 | E | Change socket to octal and rewire as follows: |

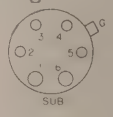
| No. 1 on six prong | to No. | 2 on octal |
|---|---|---|
| 2 | to | 3 |
| 3 | to | 4 |
| 4 | to | 5 |
| 5 | to | 6 |
| 6 | to | 7 |

| | | | |
|---|---|---|---|
| 19BG6 | 25BQ6 | P | Rewire as follows: |

| | | |
|---|---|---|
| No. 8 | to No. | 4 |
| 3 | to | 8 |

| | | | |
|---|---|---|---|
| 19C8 | 19T8 | G | No changes. |
| 19T8 | 19C8 | G | No changes. |
| 20 | X99 | G | Parallel circuits only. No changes. |
| 20J8 | | | No practical substitute. |
| 21A7 | | | No practical substitute. |
| 22 | | | No practical substitute. |
| 24A | 35/51 | G | Use as IF or RF amplifier. Does not make good detector. |
| | 57 | G | Change socket to six prong and rewire as follows: |
| | 58 | E | |

| No. 1 on five prong | to No. | 1 on six prong |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 3 |
| 4 | to | 4 and 5 |
| 5 | to | 6 |
| cap | to | cap |




| | | | |
|---|---|---|---|
| 25A6 | 25B6 | G | No changes. |
| | 25C6 | G | |
| | 25L6 | G | |
| | 43 | G | Change socket to six prong and rewire as follows: |

| No. 2 on octal | to No. | 1 on six prong |
|---|---|---|
| 3 | to | 2 |
| 4 | to | 3 |
| 5 | to | 4 |
| 7 | to | 6 |
| 8 | to | 5 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 25A6 | 5824 | G | No changes. |
| 25A7 | 32L7 | E | No changes. |
| 25AC5 | | | This is a positive bias triode output tube. Operation can be accomplished by rewiring circuit and installing standard power amplifier tube. |
| 25AV5 | 25BQ6 | G | Rewire as follows:<br>No. 8 to No. 4<br>3 to 8<br>5 to cap<br>1 to 5 |
| 25B5 | 25N6 | G | Change socket to octal and rewire as follows: |
| | 25B6 | G | |
| | 25C6 | G | |
| | 25L6 | G | |

No. 1 on six prong to No. 2 on octal
2 to 3
3 to 4
4 to 5
5 to 8
6 to 7

| | | | |
|---|---|---|---|
| | 43 | G | No changes. |
| 25B6 | 25A6 | G | No changes. |
| | 25B5 | E | Reverse 25B5 to 25N6 procedure. |
| | 25G6 | G | No changes. |
| | 25L6 | G | |
| | 25N6 | G | |
| | 43 | G | Reverse 43 to 25L6 procedure. |
| | 5824 | E | No changes. |
| 25B8GT | | | No practical substitute. |
| 25BQ6 | 19BG6 | G | Rewire as follows:<br>No. 8 to No. 3<br>4 to 8<br>Insert 20 ohm 10 watt resistor in series with filament circuit. |
| | 25AV5 | G | Rewire as follows:<br>No. 5 to No. 1<br>cap to 5<br>8 to 3<br>4 to 8 |
| 25C6 | 25A6 | G | No changes. |
| | 25B5 | G | Reverse 25B5 to 25N6 procedure. |
| | 25B6 | G | No changes. |
| | 25LG | G | |
| | 25N6 | G | No changes. |
| | 43 | G | Reverse 43 to 25L6 procedure. |
| | 5824 | G | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 25D8GT | | | No practical substitute. |
| 25L6 | 25A6 | G | No changes. |
| | 25B5 | G | Reverse 25B5 to 25N6 procedure. |
| | 25B6 | G | No changes. |
| | 25C6 | G | |
| | 25N6 | G | No changes. |
| | 43 | G | Reverse 43 to 25L6 procedure. |
| | 5824 | E | No changes. |
| 25N6 | 25B5 | G | Reverse 25B5 to 25N6 procedure. |
| 25S | 1B5 | E | No changes. |
| 25W4 | 25Z6 | E | Rewire as follows:<br>No. 8 to No. 2<br>3 to 4<br>Connect No. 4 and No. 8 together<br>3 and 5 together |
| 25X6 | 25Z6 | G | Where 25X6 is used by itself only. Replace line cord with 310 ohms. No changes. |
| | 50X6 | G | When 25X6 is used by itself, replace line cord or filament dropping resistor with 445 ohms. Change socket to loctal and rewire as follows:<br>No. 2 on octal to No. 1 on loctal<br>3 to 3<br>4 to 2<br>5 to 6<br>7 to 8<br>8 to 7<br> <br> |
| | 50Y6 | G | Where 25X6 is used by itself, replace line cord or filament dropping resistor with 445 ohms. |
| | 50Y7 | G | When 25X6 is used by itself, replace line cord or filament dropping resistor with 445 ohms. Do not use No. 6 for anchor. |
| | 50Z7 | G | |
| 25Y4 | | | No practical substitute. |
| 25Y5 | 25Z5 | E | No changes. |
| | 25Z6 | E | Same as 25Z5 to 25Z6. |
| 25Z3 | | | No practical substitute. |
| 25Z4 | 25Z6 | E | No changes. Remove and tape up wires on unused terminals. |
| 25Z5 | 6J5 | P | Connect 60 ohm 5 watt resistor in series with filament circuit, will not work in voltage doubler circuit. If one cathode is used by itself for field excitation connect 4 and 8 together. |
| | 25Y5 | E | No changes. |

| TUBE | SUB! | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 25Z5 | 25Z6 | E | Change socket to octal and rewire as follows:<br> <br><br>No. 1 on six prong to No. 2 on octal<br>2 to 3<br>3 to 4<br>4 to 8<br>5 to 5<br>6 to 7<br> <br> |
| 25Z6 | 6J5 | P | Connect 60 ohm 5 watt resistor in series with filament circuit, will not work in voltage doubler circuit. If one cathode is used by itself for field excitation connect 4 and 3 together.<br>Make adaptor as follows:<br>No. 1 on base to No. 2 on top<br>2 and 5 to 3 and 5<br>3 and 4 to 8<br>6 to 7<br><br>Can be used only in half wave circuits. If the cathodes are separate supplies in a half wave circuit connect 4 and 8 together. Insert 10 watt 75 or 100 ohm resistor in series with the filament string. |
| | 6SL7<br>6SN7 | P<br>P | Insert 75 or 100 ohm 10 watt resistor in series with the filament string. |
| | 25AC5 | P | No changes. Use only where 4 and 8 are connected together. Will not work in voltage doubler circuit. If one cathode is used by itself for field excitation tie 4 and 8 together. |
| | 25W4 | G | When 25Z6 is used as straight half wave rectifier. Rewire as follows:<br>No. 3 to No. 5<br>4 and 8 to 3<br>2 to 8 |
| | 25Z4 | G | Where 25Z6 is used as straight half wave rectifier only. Rewire as follows:<br>No. 3 to No. 5<br>4 to 8 |
| | 25Z5 | E | Change octal to six prong socket and rewire as follows:<br> <br><br>No. 2 on octal to No. 1 on six prong<br>3 to 2<br>4 to 3<br>5 to 5<br>7 to 6<br>8 to 4<br> <br> |
| | 35Z6 | G | No changes. |
| 26 | | | No practical substitute. |
| 26A6 | | | No practical substitute. |
| 26A7 | | | No practical substitute. |
| 26BK6 | 26C6 | P | No changes. |
| 26C6 | 26BK6 | P | No changes. |
| 26D6 | | | No practical substitute. |
| 27 | 56<br>485 | G<br>P | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 28D7 | 28D7W | E | No changes. |
| 28D7W | 28D7 | E | No changes. |
| 28Z5 | | | No practical substitute. |
| 30 | 1E4 | P | Change socket to octal and rewire as follows: |
| | 1G4 | P | No. 1 on four prong to No. 2 on octal<br>2 to 3<br>3 to 5<br>4 to 7 |
| | 1H4 | E | |
| | 31 | G | Parallel circuits only. No changes. |
| 31 | 30 | G | Parallel circuits only. No changes. |
| 32 | 1A4 | G | No changes. 34 does not make good detector. |
| | 1B4 | G | |
| | 34 | G | |
| | 951 | G | |
| 32L7 | 25A7 | E | No changes. |
| | 70A7 | G | No changes. Difference in filament current makes necessary line resistanc the same. Use only where 32L7 does not have other tubes in series with it. |
| | 70L7 | G | Reverse 6 and 8. Cord is correct.<br>Use only where 32L7 does not have other tubes in series with it. |
| | 117L7 | G | Remove or short out the filament resistor and reverse connections 4 and 5 |
| | 117M7 | G | to socket. |
| | 117N7 | G | Remove or short out filament resistor. Change connections as follows: |
| | 117P7 | G | No. 6 to 7<br>8 to 6<br>1 to 8<br>4 to 5<br>5 to 4<br>Use only in conventional circuits where rectifier is first in the string and A.C. is connected to No. 7. |
| 33 | 1F4 | G | Parallel circuits only. No changes. |
| | 950 | E | |
| 34 | 1A4 | G | No changes. |
| | 1B4 | G | |
| | 32 | G | |
| | 951 | G | |
| 35A5 | 6G6 | P | Same as 35A5 to 35L6 but put a 250 ohm 10 watt resistor in series with the filament circuit. |
| | 12A6 | P | Same as above but put a 250 ohm 10 watt resistor in series with filament circuit. |
| | 14A5 | P | Put 125 ohm 10 W resistor in series with filament. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 35A5 | 35B5 | E | Change socket to miniature and rewire as follows: |
| | 50B5 | G | |

| | | | |
|---|---|---|---|
| No. 1 on loctal | to | No. 3 on miniature | |
| 2 | to | 5 | |
| 3 | to | 6 | |
| 6 | to | 1 | |
| 7 | to | 2 | |
| 8 | to | 4 | |

Do not use No. 7 on miniature.

| | | | |
|---|---|---|---|
| | 35C5 | E | Change socket to minature and rewire as follows: |
| | 50C5 | G | |

| | | | |
|---|---|---|---|
| No. 1 on loctal | to | No. 3 on miniature | |
| 2 | to | 7 | |
| 3 | to | 6 | |
| 6 | to | 2 | |
| 7 | to | 1 | |
| 8 | to | 4 | |

Do not use No. 5 on miniature.

| | | | |
|---|---|---|---|
| | 35L6 | E | Change socket to octal and rewire as follows: |
| | 50L6 | G | |

| | | | |
|---|---|---|---|
| No. 1 on loctal | to | No. 2 on octal | |
| 2 | to | 3 | |
| 3 | to | 4 | |
| 6 | to | 5 | |
| 7 | to | 8 | |
| 8 | to | 7 | |

| | | | |
|---|---|---|---|
| | 50A5 | G | No changes. |
| 35B5 | 35A5 | E | Where space permits. Change socket to loctal and rewire as follows. |
| | 50A5 | G | |

| | | | |
|---|---|---|---|
| No. 1 on miniature | to | No. 6 on loctal | |
| 2 | to | 7 | |
| 3 | to | 1 | |
| 4 | to | 8 | |
| 5 | to | 2 | |
| 6 | to | 3 | |
| 7 | to | 5 | |

| | | | |
|---|---|---|---|
| | 35C5 | E | Rewire as follows: |
| | 50C5 | G | Reverse No. 1 and No. 2 |
| | | | 5 and 7 |
| | 35L6 | E | Where space permits. Change socket to octal and rewire as follows: |
| | 50L6 | G | |

| | | | |
|---|---|---|---|
| No. 1 on miniature | to | No. 5 on octal | |
| 2 | to | 8 | |
| 3 | to | 2 | |
| 4 | to | 7 | |
| 5 | to | 3 | |
| 6 | to | 4 | |
| 7 | to | 5 | |

| | | | |
|---|---|---|---|
| | 50B5 | G | No changes. |
| 35C5 | 35A5 | E | Where space permits, change socket to loctal and rewire as follows: |
| | 50A5 | G | |

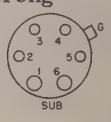
| | | | |
|---|---|---|---|
| No. 1 on miniature | to | No. 7 on loctal | |
| 2 | to | 6 | |
| 3 | to | 1 | |
| 4 | to | 8 | |
| 5 | to | 6 | |
| 6 | to | 3 | |
| 7 | to | 2 | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 35L6 | 6G6 | P | Put 250 ohm 10 watt resistor in series with filament circuit. |
| | 12A6 | P | Insert 150 ohms resistance in series with the filament circuit. |
| | 12J5 | P | Insert 150 ohms resistance in series with the filament circuit. |
| | 35A5 | E | Change socket to loctal and rewire as follows: |
| | 50A5 | G | No. 2 on octal to No. 1 on loctal<br>3 to 2<br>4 to 3<br>5 to 6<br>8 to 7<br>7 to 8 |
| | 35B5 | E | Change socket to miniature and rewire as follows: |
| | 50B5 | G | No. 2 on octal to No. 3 on miniature<br>3 to 5<br>4 to 6<br>5 to 1<br>7 to 4<br>8 to 2<br>Do not use No. 7 on miniature. |
| | 35C5 | E | Change socket to miniature and rewire as follows: |
| | 50C5 | G | No. 2 on octal to No. 3 on miniature<br>3 to 7<br>4 to 6<br>5 to 2<br>7 to 4<br>8 to 1<br>Do not use terminal No. 5 on miniature. |
| | 50C6 | G | No changes. |
| | 50L6 | G | |
| 35W4 | 35Y4 | E | Where space permits. Reverse 35Y4 to 35W4 procedure. |
| | 35Z3 | E | |
| | 35Z5 | E | |
| | 117Z3 | G | Where 35W4 is used by itself only. Remove line cord resistor or filament dropping resistor and replace with ordinary line cord. Rewire as follows:<br>Remove and tape up any wires on No. 6<br>No. 7 to No. 6<br>Pilot light will not burn. In order to light pilot light, connec 40 ohm 1 watt resistor in series with filament and connect pilot light across it. |
| 35Y4 | 35W4 | E | Change socket to miniature and rewire as follows:<br>No. 1 on loctal to No. 3 on miniature<br>2 to 5<br>4 to 6<br>7 to 7<br>8 to 4 |
| | 35Z3 | E | No change is necessary but pilot light will not light. Pilot light can be lit by same method as used from 35Z5 to 35Z4. |

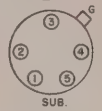
| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 35Y4 | 35Z5 | E | Change socket to octal and rewire as follows: |
| | 40Z5 | E | No. 1 on loctal to No. 2 on octal<br>2 to 5<br>4 to 3<br>7 to 8<br>8 to 7 |
| | 45Z5 | E | |
| 35Z3 | 7A6 | P | Move wire from No. 2 to No. 3. Short 3 and 6 together and 2 and 7 together. Connect 200 ohm 10W resistor in series with filament circuit. |
| | 35W4 | E | Change socket to miniature and rewire as follows : |
| | | | No. 1 on loctal to No. 3 on miniature<br>2 to 5<br>7 to 7<br>8 to 4 <br>Do not anchor on unused terminals. |
| | 35Y4 | E | No changes. Remove wires, if any, from pin No. 4 and tape them up. |
| | 35Z4 | E | Change socket to octal and rewire as follows: |
| | 35Z5 | E | No. 1 on loctal to No. 2 on octal<br>2 to 5<br>7 to 8<br>8 to 7 |
| | 45Z5 | G | Same as 35Z3 to 35Z4. |
| | 40Z5 | G | |
| 35Z4 | 12J5 | P | Add 150 ohm 5W resistor in series with filaments. Short Nos. 3 and 5. |
| | 35W4 | E | Change socket to miniature and rewire as follows: |
| | | | No. 2 on octal to No. 3 on miniature<br>5 to 5<br>7 to 4<br>8 to 7 <br>Do not connect to unused terminals. |
| | 35Y4 | E | Change socket to loctal and rewire as follows: |
| | 35Z3 | E | No. 2 on octal to No. 1 on loctal<br>5 to 2<br>7 to 8<br>8 to 7 |
| | 35Z5 | E | No change is necessary but remove wires, if any, from pin No. 3 and tape them up. |
| | 40Z5 | E | |
| | 45Z5 | E | |
| 35Z5 | 12J5 | P | Add 150 ohm 5W resistor in series with filaments. Remove wires from No. 3 and connect to No. 2 through 25 or 30 ohm 1W resistor. Short Nos. 3 and 5. |
| | 35W4 | E | Change socket to miniature and rewire as follows: |
| | | | No. 2 on octal to No. 3 on miniature.<br>3 to 6<br>5 to 5<br>7 to 4<br>8 to 7 <br>Do not connect to unused terminals. |
| | 35Y4 | E | Change socket to loctal and rewire as follows: |
| | | | No. 2 on octal to No. 1 on loctal<br>3 to 4<br>5 to 2<br>7 to 8<br>8 to 7 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 35Z5 | 35Z4 | E | No change is necessary but pilot light will not light. In order to light the pilot light, put a 40 ohm resistor in series with the filaments and connect the pilot light across it. This resistor must have a 1 watt rating. |
| | 45Z5 | G | No changes. |
| 35Z6 | 25Z6 | G | No change, unless 35Z6 is used singly in which case put 35 ohm 10 watt resistor in filament string. |
| | 50Z6 | G | No changes. Where a full set of five or six tubes are used, little change in operation will be noted. If 35Z6 is used by itself, this substitution may not be satisfactory. |
| 35/51 | 24A | G | No changes. |
| 36 | 6C6 | E | Same as 37/44 to 6D6. |
| | 6D6 | G | |
| | 39/44 | G | No changes. |
| | 77 | E | Same as 39/44 to 6D6. |
| | 78 | G | |
| 37 | 76 | E | No changes. |
| 38 | 41 | G | Parallel circuits only. Reverse 41 to 38 procedure. |
| | 42 | G | |
| 39/44 | 6C6 | G | Change socket to six prong and rewire as follows: |
| | 6D6 | E | |
| | 77 | G | |
| | 78 | E | |

| No. | 1 on five prong | to No. | 1 on six prong |
|---|---|---|---|
| | 2 | to | 2 |
| | 3 | to | 3 |
| | 4 | to | 4 and 5 |
| | 5 | to | 6 |
| | cap | to | cap |




| | | | |
|---|---|---|---|
| | 6J7 | G | Reverse 6K7 to 39/44 procedure. |
| | 6K7 | E | |
| | 6S7 | G | Reverse 6K7 to 39/44 procedure. Parallel circuits only. |
| | 6SH7 | G | Reverse 6SK7 to 39/44 procedure. |
| | 6SJ7 | G | |
| | 6SK7 | E | |
| | 6SS7 | G | Reverse 6SK7 to 39/44 procedure. Parallel circuits only. |
| | 6U7 | G | Reverse 6K7 to 39/44 procedure. |
| | 6W7 | G | |
| | 7A7 | E | Reverse 7A7 to 39/44 procedure. |
| | 7H7 | G | |
| | 7L7 | G | |
| | 7B7 | G | Reverse 7A7 to 39/44 procedure. Parallel circuits only. |
| | 7C7 | G | |
| | 36 | G | No changes. |
| 40 | 00A | G | No changes. |
| | 01A | G | |
| | 12A | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 41 | 6A4/LA | G | Parallel circuits only. Reverse 6A4/LA to 42 procedure. |
| | 6AD7 | G | Reverse 6F6 to 41 procedure. Parallel circuits only. Connect nothing to unused pins. |
| | 6AR5 | G | Change socket to miniature and rewire as follows:<br>No. 1 on six prong to No. 3 on miniature<br>2 to 5<br>3 to 6<br>4 to 1<br>5 to 2<br>6 to 4<br> <br> |
| | 6F6 | G | Parallel circuits only. Reverse 6F6 to 41 procedure. |
| | 6G6 | P | |
| | 6L6 | G | |
| | 6U6 | G | |
| | 6V6 | G | |
| | 6K6 | E | Reverse 6F6 to 41 procedure. |
| | 7A5 | G | Parallel circuits only. Reverse 7B5 to 41 procedure. |
| | 7B5 | E | Reverse 7B5 to 41 procedure. |
| | 7C5 | G | Parallel circuits only. Reverse 7B5 to 41 procedure. |
| | 38 | G | Parallel circuits only. Change socket to five prong and rewire as follows:<br>No. 1 on six prong to No. 1 on five prong<br>2 to 2<br>3 to 3<br>4 to cap<br>5 to 4<br>6 to 5<br> <br>  |
| | 42 | G | No changes. |
| | 89 | G | Change socket connections as follows:<br>Move wire from No. 4 to cap. Short Nos. 4 and 5 together. |
| 42 | 6A4/LA | G | Parallel circuits only. Reverse 6A4/LA to 42 procedure. |
| | 6AD7 | G | Parallel circuits only. Reverse 6F6 to 41 procedure. Remove and tape up any wires connected to unused pins. |
| | 6AR5 | G | Same as 41 to 6AR5. Parallel circuits only. |
| | 6B5 | G | No changes. |
| | 6F6 | E | Reverse 6F6 to 41 procedure. |
| | 6G6 | P | Parallel circuits only. Reverse 6F6 to 41 procedure. |
| | 6K6 | G | |
| | 6L6 | G | |
| | 6U6 | G | |
| | 6V6 | G | |
| | 7A5 | G | Reverse 7B5 to 41 procedure. |
| | 7B5 | G | Parallel circuits only. Reverse 7B5 to 41 procedure. |
| | 7C5 | G | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 42 | 38 | G | Same as 41 to 38. Parallel circuits only. |
| | 41 | G | No changes. |
| | 89 | G | Same as 41 to 89. Parallel circuits only. |
| 43 | 25A6 | G | Reverse 25A6 to 43 procedure. |
| | 25L6 | E | Change socket to octal and rewire as follows: |
| | 25B6 | G | |
| | 25C6 | G | |
| | 5824 | G | |

| No. 1 on six prong | to No. | 2 on octal |
|---|---|---|
| 2 | to | 3 |
| 3 | to | 4 |
| 4 | to | 5 |
| 5 | to | 8 |
| 6 | to | 7 |

| | | | |
|---|---|---|---|
| 45 | 2A3 | G | No changes. |
| 45Z3 | 35W4 | G | Where 45Z3 is used by itself only, remove 960-ohm line cord resistor or filament dropping resistor and replace with 550-ohm. Rewire as follows: |

| No. 1 | to No. | 3 |
|---|---|---|
| 2 | to | 5 |
| 6 | to | 5 |

Reverse Nos. 4 and 7
Do not anchor to unused terminals.

| | | | |
|---|---|---|---|
| | 117Z3 | G | Where 45Z3 is used by itself only, remove line cord resistor or filament dropping resistor and replace with ordinary line cord. Rewire as follows: |

| No. 7 | to No. | 3 |
|---|---|---|
| 2 and 6 | to | 5 |
| 4 | to | 6 |
| 1 | to | 4 |

| | | | |
|---|---|---|---|
| 45Z5 | 35Z5 | G | No changes. |
| 46 | 47 | G | Only when 46 is operated as class A with plate and screen tied together. |
| 47 | 2A5 | G | Change socket to six prong type and rewire as follows: |

| No. 1 on five prong | to No. | 1 on six prong |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 4 |
| 4 | to | 3 |
| 5 | to | 6 |

Connect 5 and 6 together.

| | | | |
|---|---|---|---|
| | 46 | P | Remove wire from No. 4 and short Nos. 2 and 4 together. |
| | 59 | G | Change socket to seven prong and rewire as follows: |

| No. 1 on five prong | to No. | 1 on seven prong |
|---|---|---|
| 2 | to | 2 |
| 3 | to | 4 |
| 4 | to | 3 |
| 5 | to | 5,6 and 7 |

| | | | |
|---|---|---|---|
| | 1619 | G | Parallel circuits only. Make adaptor as follows: |

| No. 1 on base | to No. | 2 on top |
|---|---|---|
| 2 | to | 3 |
| 3 | to | 5 |
| 4 | to | 4 |
| 5 | to | 7 and 8 |

There are or will be many used 1619 tubes available.

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 48 | | | No practical substitute. |
| 49 | | | No practical substitute. |
| 50 | 10 | G | No changes. |
| 50A5 | 35A5 | E | No changes. Place 100-ohm resistor in filament circuit. |
| | 35B5 | E | Same as 35A5 to 35B5. Place 100-ohm 10-W resistor in series with filaments. |
| | 35C5 | E | Same as 35A5 to 35C5. Place 100-ohm 10-W resistor in series with filament. |
| | 35L6 | E | Same as 35A5 to 35L6. Place 100-ohm resistor in filament circuit. |
| | 50B5 | E | Same as 35A5 to 35B5. |
| | 50C5 | E | Same as 35A5 to 35C5. |
| | 50C6 | G | Same as 35A5 to 35L6. |
| | 50L6 | E | |
| 50AX6 | 50Z6 | G | No changes. |
| 50B5 | 35B5 | E | Place 100 ohms 5 watts in series with filament. |
| | 50A5 | G | Where space permits. Same as 35B5 to 35A5. |
| | 50C5 | E | Same as 35B5 to 35C5. |
| | 50L6 | G | Where space permits. Same as 35B5 to 35L6. |
| 50C5 | 50A5 | G | Where space permits. Same as 35C5 to 35A5. |
| | 50L6 | E | Where space permits. Reverse 35L6 to 35C5 procedure. |
| 50C6 | 35L6 | G | Place 100-ohm 10-W resistor in series with filament. |
| | 50A5 | G | Same as 35L6 to 35A5. |
| | 50L6 | G | No changes. |
| 50L6 | 12A6 | P | No changes. Connect a 250-ohm 10-W resistor in series with the filament circuit. |
| | 12J5 | P | Emergency substitution. Works well at low volume. Put 250-ohm 10-w resistor in series with filaments. |
| | 35A5 | E | Same as 35L6 to 35A5. Place 100-ohm 5-w resistor in series with filaments. |
| | 35B5 | E | Same as 35L6 to 35B5. Place 100-ohm 10-w resistor in series with filament. |
| | 35C5 | E | Same as 35L6 to 35C5. Place 100-ohm 10-w resistor in series with filament. |
| | 35L6 | E | Place 100-ohm 5-w resistance in series with filaments. |
| | 50B5 | E | Same as 35L6 to 35B5. |
| | 50C5 | E | Same as 35L6 to 35C5. |
| | 70A7 | P | Remove and tape up wires connected to No. 6 or cut off No. 6 pin on 70A7. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 50X6 | 25X6 | G | Insert 160-ohm 10-w resistor in series with filament. Reverse 25X6 to 50X6 procedure. |
| | 50Y6 | G | Reverse 25X6 to 50X6 procedure. |
| | 50Y7 | E | Change socket to octal and rewire as follows: |
| | 50Z7 | E | |

| No. 1 on loctal | to No. | 2 on octal |
|---|---|---|
| 2 | to | 4 |
| 3 | to | 3 |
| 6 | to | 5 |
| 7 | to | 8 |
| 8 | to | 7 |

Do not use No. 6 for anchor.

| | | | |
|---|---|---|---|
| 50Y6 | 50Z7 | E | No changes. Disconnect wires from pin No. 6, if any. |
| 50Y7 | 25X6 | G | Insert 160-ohm 10-w resistor in series with filament. Reverse 25X6 to 50Y7 procedure. |
| | 50X6 | G | Only when No. 7 filament tap on 50Y7 is not used. Reverse 50X6 to 50Y7 procedure. |
| | 50Y6 | G | Only when No. 7 filament tap on 50Y7 is not used. Reverse 25X6 to 50Y7 procedure. |
| | 50Z7 | G | No changes. |
| 50Z6 | 25Z6 | E | No changes. Place 83-ohm 20-w resistor in series with filament. |
| | 35Z6 | E | Place 50-ohm resistor in series with filament. |
| | 50AX6 | E | No changes. |
| 50Z7 | 50Y6 | E | No changes are necessary but pilot light will not light. You may light pilot light by inserting 40 ohms resistance in series with the filament circuit and connecting the pilot light across it. |
| | 50Y7 | G | No changes. |
| EF50 | 6AH6 | G | Same as EF50 to 6AU6. Parallel circuits only. |
| | 6AK6 | G | |
| | 6AU6 | G | Change socket to miniature and rewire as follows: |
| | 6BA6 | G | |
| | 6BD6 | G | |

| No. 1 on noval | to No. | 3 on miniature |
|---|---|---|
| 2 | to | 6 |
| 3 | to | 5 |
| 4 | to | 2 |
| 6 | to | 7 |
| 7 | to | 1 |
| 9 | to | 4 |

| | | | |
|---|---|---|---|
| 52 | | | No practical substitution. |
| VT52 | 10 | P | Parallel circuits only. No changes. |
| | 50 | P | |
| 53 | 5608-A | E | No changes. |
| 55 | 2A6 | E | No changes. |
| 55S | 2A6 | E | No changes. |
| | 55 | E | |

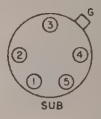
| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 56 | 27 | G | No changes. |
| | 485 | G | No changes. |
| 56AS | 37 | E | Parallel circuits only. No changes. |
| | 76 | E | |
| 56S | 27 | E | No changes. |
| | 56 | E | |
| 57 | 58 | G | No changes. |
| 57AS | 6C6 | E | Parallel circuits only. No changes. |
| | 77 | E | |
| 57S | 57 | E | No changes. |
| | 58 | E | |
| 58 | 57 | G | No changes. 58 is not a good second detector. |
| 58AS | 6D6 | E | Parallel circuits only. No changes. |
| | 78 | E | |
| 58S | 57 | E | No changes. |
| | 58 | E | |
| 59 | 47 | G | Reverse 47 to 59 procedure. |
| | 1619 | G | Parallel circuits only. Make adaptor as follows:<br>No. 1 on base to No. 2 on top<br>2 to 3<br>3 to 4<br>4 to 5<br>5 and 6 to 8<br>7 to 7<br>There are or will be many used 1619 tubes available. |
| 70A7 | 32L7 | G | No changes. Where no other tubes in series with the 70A7 which has 150 mil filament instead of 0.3 amp. |
| | 70L7 | E | Change connection as follows:<br>No. 8 to No. 6<br>6 to 8<br>Connect Nos. 7 and 8 together.<br>Pilot light will not light but may be lit by same procedure as 50Z7 to 50Y6. |
| | 117L7 | E | Remove the line cord resistor and replace with straight AC cord. Reverse connections to 4 and 5. |
| | 117M7 | E | |
| | 117N7 | E | Remove line resistor cord and replace with straight AC cord. |
| | 117P7 | E | Remove wire from No. 8<br>Move No. 1 to No. 8<br>Reverse Nos. 4 and 5<br>Move No. 6 to No. 7<br>Place No. 8 on No. 6 |
| 70L7 | 32L7 | G | Cord is correct. If 32L7 is alone in circuit. Reverse Nos. 6 and 8. |
| | 70A7 | E | Change connections as follows:<br>No. 6 to No. 8<br>8 to 6 |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 70L7 | 117L7 | E | Remove line resistor cord and replace with straight AC cord. |
| | 117M7 | E | Reverse Nos. 4 and 5<br>Reverse 6 and 8 |
| | 117N7 | E | Remove line cord resistor and replace with straight AC cord. |
| | 117P7 | E | Reverse Nos 4 and 5<br>No. 8 on No. 7<br>1 on 8 |
| 71A | 482 | G | No changes. If push-pull circuit, both tubes must be changed to avoid hum. |
| | 483 | G | |
| 75 | 6AQ6 | G | Same as 75 to 6AT6. Parallel circuits only. |
| | 6AT6 | G | Change socket to miniature and rewire as follows: |
| | 6AV6 | G | No. 1 on six prong to No. 3 on miniature |
| | 6BF6 | G | 2 to 7 |
| | 6BK6 | G | 3 to 5 |
| | 6BT6 | G | 4 to 6 |
| | 6BU6 | G | 5 to 2 |
| | | | 6 to 4 |
| | | | cap to 1 |
| | 6B6 | E | Change socket to octal and rewire as follows: |
| | 6Q7 | E | No. 1 on six prong to No. 2 on octal |
| | 6R7 | G | 2 to 3 |
| | | | 3 to 4 |
| | | | 4 to 5 |
| | | | 5 to 8 |
| | | | 6 to 7 |
| | | | cap to cap |
| | 6C6 | P | Emergency substitution. No changes but considerable loss of volume. |
| | 6SQ7 | E | Reverse 6SQ7 to 75 procedure. |
| | 6SR7 | G | |
| | 6T7 | G | Same as 75 to 6Q7. Parallel circuits only. |
| | 6V7 | G | Same as 75 to 6Q7. |
| | 7B6 | E | Change socket to loctal and rewire as follows: |
| | 7E6 | G | No. 1 on six prong to No. 1 on loctal |
| | | | 2 to 2 |
| | | | 3 to 5 |
| | | | 4 to 6 |
| | | | 5 to 4 or 7 |
| | | | 6 to 8 |
| | | | cap to 3 |
| | 7C6 | G | Same as above. Parallel circuits only. |
| | 85 | G | No changes. Sometimes works excellent, other times not so well. |
| 76 | 6AE5 | G | Reverse 6C5 to 37 procedure. |
| | 6C5 | E | Reverse 6C5 to 37 procedure. |
| | 6J5 | G | Reverse 6C5 to 37 procedure. |

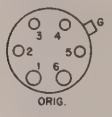
| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 76 | 6L5 | G | Reverse 6C5 to 37 procedure. |
| | 6P5 | G | Reverse 6C5 to 37 procedure. |
| | 7A4 | E | Reverse 7A4 to 37 procedure. |
| | 7B4 | G | |
| | XXL | E | |
| | 37 | E | No changes. |
| 77 | 6C6 | E | No changes. |
| | 6D7 | G | Same as 6C6 to 6D7. |
| | 6E7 | G | |
| | 6J7 | E | |
| | 6K7 | G | Same as 6C6 to 6J7. |
| | 6S7 | G | Same as 6C6 to 6J7. Parallel circuits only. |
| | 6SH7 | G | Same as 6C6 to 6SJ7. |
| | 6SJ7 | E | Same as 6C6 to 6SJ7. |
| | 6SK7 | G | Same as 6C6 to 6SJ7. |
| | 6U7 | G | Same as 6C6 to 6J7. |
| | 6W7 | G | Same as 6C6 to 6J7. Parallel circuits only. |
| | 7A7 | G | Same as 6C6 to 7A7. |
| | 7B7 | G | Same as 6C6 to 7A7. Parallel circuits only. |
| | 7C7 | G | |
| | 7H7 | G | Same as 6C6 to 7A7. |
| | 7L7 | G | Same as 6C6 to 7A7. |
| | 1221 | E | No changes. |
| 78 | 6D6 | E | No changes. |
| | 6D7 | G | Same as 6C6 to 6D7. |
| | 6E7 | G | |
| | 6J5 | G | Same as 6C6 to 6J7. |
| | 6K7 | E | |
| | 6S7 | G | Same as 6C6 to 6J7. Parallel circuits only. |
| | 6SH7 | G | Same as 6C6 to 6SJ7. |
| | 6SJ7 | G | Same as 6C6 to 6SJ7. |
| | 6SK7 | E | Same as 6C6 to 6SJ7. |
| | 6U7 | G | Same as 6C6 to 6J7. |
| | 6W7 | G | Same as 6C6 to 6J7. Parallel circuits only. |
| | 7A7 | E | Same as 6C6 to 7A7. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 78 | 7B7 | G | Same as 6C6 to 7A7. Parallel circuits only. |
| | 7C7 | G | Same as 6C6 to 7A7. Parallel circuits only. |
| | 7H7 | G | Same as 6C6 to 7A7. |
| | 7L7 | G | Same as 6C6 to 7A7. |
| | 39/44 | E | Change socket to five prong type and rewire as follows: |

| No. 1 on six prong | to No. 1 on five prong |
|---|---|
| 2 | to 2 |
| 3 | to 3 |
| 4, remove and tape up | |
| 5 | to 4 |
| 6 | to 5 |
| cap | cap |




| | | | |
|---|---|---|---|
| 79* | 6A6 | G | Parallel circuits only. Change socket to seven prong and rewire as follows: |



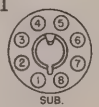

| No. 1 on six prong | to No. 1 on seven prong |
|---|---|
| 2 | to 2 |
| 3 | to 3 |
| 4 | to 4 |
| 5 | to 6 |
| 6 | to 7 |
| cap | to 5 |

| | | | |
|---|---|---|---|
| | 6N7 | G | Parallel circuits only. Reverse 6N7 to 79 procedure. |
| | 6Y7G | G | Reverse 6N7 to 79 procedure. |
| | 6Z7 | G | Parallel circuits only. Reverse 6N7 to 79 procedure. |
| 80 | 5T4 | G | Change socket to octal and rewire as follows: |
| | 5U4 | G | |
| | 5V4 | G | |
| | 5W4 | G | |
| | 5Y3 | E | |
| | 5Z4 | G | |

| No. 1 on four prong | to No. 2 on octal |
|---|---|
| 2 | to 4 |
| 3 | to 6 |
| 4 | to 8 |

| | | | |
|---|---|---|---|
| | 5X4 | G | Reverse 5X4 to 5Z3 procedure. |
| | 5Y4 | E | |
| | 83V | G | No changes. |
| | 83 | G | |
| | 5Z3 | G | No changes. |
| 81 | 10 | P | No changes. |
| | 50 | P | |
| 82 | 2A3 | P | No changes. |
| | 45 | P | |
| 83 | 5T4 | G | Same as 80 to 5U4. |
| | 5U4 | G | |
| | 5X4 | G | Reverse 5X4 to 5Z3 procedure. |
| | 5Z3 | G | No changes. |

* See Addendum at back of this section.

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 83V | 5T4 | G | Same as 80 to 5U4. |
| | 5U4 | G | |
| | 5V4 | G | |
| | 5W4 | G | |
| | 5Y3 | G | |
| | 5Z3 | G | No changes. |
| | 5Z4 | G | Same as 80 to 5U4. |
| | 80 | G | No changes. |
| | 83 | G | |
| 84 | 7Y4 | E | Change socket to loctal and rewire as follows:<br> <br>ORIG.<br>No. 1 on five prong to No. 1 on loctal<br>2 to 3<br>3 to 6<br>4 to 7<br>5 to 8<br>  <br>SUB. |
| 84/6Z4 | 6X4 | G | Parallel circuits only. Change socket to miniature and rewire as follows:<br> <br>ORIG.<br>No. 1 on five prong to No. 3 on miniature<br>2 to 1<br>3 to 6<br>4 to 7<br>5 to 4<br> <br>SUB. |
| | 6X5 | E | Change socket to octal and rewire as follows:<br> <br>ORIG.<br>No. 1 on five prong to No. 2 on octal<br>2 to 3<br>3 to 5<br>4 to 8<br>5 to 7<br> <br>SUB. |
| 85 | 6AQ6 | G | Same as 75 to 6AT6. Parallel circuits only. |
| | 6AT6 | G | Same as 75 to 6AT6. |
| | 6AV6 | G | |
| | 6B6 | G | Same as 75 to 6Q7. |
| | 6BF6 | G | Same as 75 to 6AT6. |
| | 6BK6 | G | |
| | 6BT6 | G | |
| | 6BU6 | G | |
| | 6Q7 | G | Same as 75 to 6Q7. |
| | 6R7 | E | |
| | 6SQ7 | G | Reverse 6SQ7 to 75 procedure. |
| | 6SR7 | E | |
| | 6T7 | G | Same as 75 to 6Q7. Parallel circuits only. |
| | 6V7 | G | Same as 75 to 6Q7. |
| | 7B6 | G | Same as 75 to 7E6. |
| | 7C6 | G | Same as 75 to 7E6. Parallel circuits only. |
| | 7E6 | G | Same as 75 to 7E6. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 85 | 75 | G | No changes. |
| 85AS | 85 | E | No changes. |
| 89 | 6K6 | G | Same as 6F6 to 89. Parallel or series circuits. |
| | 41 | G | Reverse 41 to 89 procedure. |
| | 42 | G | Parallel circuits only. Reverse 41 to 89 procedure. |
| 99V | | | No practical substitution. |
| X99 | 20 | G | Parallel circuits only. No changes. |
| 117L7 | 32L7 | G | Place 280-ohm cord or 50-w resistor in series with filaments. Reverse socket connections Nos. 4 and 5. |
| | 70A7 | G | Place 300-ohm cord or 10-w resistor in series with filaments. Reverse socket connections Nos. 4 and 5. |
| | 70L7 | G | Place 300-ohm 10-w resistor in series with filaments. Reverse socket connections Nos. 4 and 5, also 6 and 8. |
| | 117M7 | E | No changes. |
| 117L7 or 117M7 | 117N7 or 117P7 | E | Make adaptor as follows:<br>No. 1 on base to No. 8 on top<br>2 to 2<br>3 to 3<br>4 to 4<br>5 to 5<br>7 to 7<br>8 to 6<br>AC line must connect to No. 7 |
| 117L7/M7 | 25A7 | G | Connect 300-ohm line cord in place of AC cord and change connections as follows:<br>Reverse Nos. 4 and 5. |
| 117M7 | 32L7 | G | Same as 117L7 to 32L7. |
| | 70A7 | G | Same as 117L7 to 70A7. |
| | 70L7 | G | Same as 117L7 to 70L7. |
| 117N7 | 25A7 | G | Connect 300-ohm line cord in place of AC cord and change connections as follows:<br>No. 6 to No. 7<br>8 to 6<br>1 to 8<br>Reverse Nos. 4 and 5. |
| | 32L7 | G | Remove and tape up any wire anchored on No. 1. Place 280-ohm cord or 50-w resistor in series with filaments. Reverse socket connections Nos. 4 and 5. Move No. 8 to No. 1. |
| | 70A7 | G | Place 300-ohm cord or 10-w resistor in series with filaments. Reverse socket connections Nos. 4 and 5. Move No. 8 to No. 1 and No. 6 to No. 8. |
| | 70L7 | G | Remove and tape up any wires connected to No. 1. Place 300-ohm cord or 10-w resistor in series with filaments. Reverse Nos. 4 and 5, move No. 8 to No. 1 and short Nos. 7 and 8 together. For use in circuits where AC line is connected to No. 7. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 117N7 | 117P7 | E | No changes. |
| 117P7 | 25A7 | G | Same as 117N7 to 25A7. Cord or resistor must dissipate 90 w. |
| 117Z3 | 35W4 | G | Replace line cord with 533-ohm resistor cord. Rewire as follows:<br>No. 6 to No. 7<br>Do not use No. 6 for anchor. |
| | 45Z3 | G | Replace line cord with 960-ohm resistor cord. Rewire as follows.<br>No. 3 to No. 1<br>4 to 7<br>5 to 2<br>6 to 4<br>Do not use unused terminals for anchors. |
| | 117Z4 | G | Where space permits. Change socket to octal and rewire as follows:<br> <br><br>No. 3 on miniature to No. 2 on octal<br>4 to 7<br>5 to 5<br>6 to 8<br> <br> |
| 117Z4 | 117Z3 | G | Reverse 117Z3 to 117Z4 procedure. |
| | 117Z6 | E | No change except to remove and tape up any wires which may be anchored to Nos. 3 and 4. |
| 117Z6 | 6X5 | P | Connect 200-ohm 100-w resistor in series with filament. Use only where Nos. 4 and 8 are tied together. |
| | 25Z6 | G | Connect 300-ohm line cord or 50-w resistor in series with filament. |
| | 50Y6 | E | No change except that a 450-ohm 20-w resistor or line cord must be used in series with the filament. |
| | 50Z6 | E | Connect 220-ohm line cord in place of AC cord. |
| | 50Z7 | E | Connect 440-ohm line cord in place of AC cord. |
| 182B/482B | 71A | E | No changes. |
| | 183/483 | E | |
| 183/483 | 71A | E | No changes. |
| | 182B/482B | E | |
| 210T | VT52 | P | No changes. |
| | 10 | E | |
| | 50 | G | |
| 485 | 27 | G | No changes in connections but put one inch piece of screen wire doubled in series with one side of filament winding. |
| | 56 | G | Same as 485 to 27. |
| 864 | | | No practical substitute. |
| 950 | 1F4 | G | No changes. |
| | 33 | G | Parallel circuits only. No changes. |
| 954 | 956 | E | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 955 | 5731 | P | No changes. |
| 956 | 954 | E | No changes. |
| 957 | 958A | G | Parallel circuits only. No changes. |
| 958A | 957 | G | Parallel circuits only. No changes. |
| 959 | | | No practical substitute. |
| FM1000 | | | No practical substitute. |
| 1005/CK1005 | 0Y4 | G | No changes. |
| | 0Z4A | G | |
| CK1013 | 5517 | E | No changes. |
| 1201 | 7E5 | E | No changes. |
| 1203 | 7C4 | E | No changes. |
| 1204 | 7AB7 | E | No changes. |
| 1206 | 7G8 | E | No changes. |
| 1221 | 6C6 | E | No changes. |
| | 77 | E | |
| 1223 | 6J7 | E | No changes. |
| 1229 | 1A4 | E | No changes. |
| | 1B4 | E | |
| | 32 | E | |
| | 951 | E | |
| 1230 | 30 | E | No changes. |
| 1231 | 7G7 | G | No changes. |
| | 7V7 | G | |
| 1232 | 7G7 | E | No changes. |
| 1247 | | | No practical substitute. |
| 1265 | | | No practical substitute. |
| 1266 | | | No practical substitute. |
| 1267 | 0A4 | G | No changes. |
| 1273 | 7A7 | G | No changes. |
| | 7AJ7 | G | |
| | 7H7 | G | |
| | 7L7 | G | |
| | 7T7 | G | |
| 1274 | 6AX5 | G | Parallel circuits only. No changes. |
| | 6W5 | G | |
| | 6ZY5 | G | |
| | 6AX6 | G | No change necessary but tie Nos. 4 and 8 together if convenient. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 1274 | 6BY5 | G | Parallel circuits only. Rewire as follows: Connect Nos. 1 and 8 together No. 3 to No. 4 |
| | 6X5 | E | No changes. |
| | 7Y4 | E | Same as 6X5 to 7Y4. Parallel circuits only. |
| | 7Z4 | E | |
| 1275 | 5X3 | G | No changes. |
| | 5Z3 | E | |
| | 80 | G | |
| | 83 | G | |
| | 83V | G | |
| 1276 | | | No practical substitute. |
| 1280 | 12B7 | G | No changes. |
| | 14A7 | G | No changes. |
| | 14C7 | G | |
| | 14H7 | E | |
| | 1284 | G | |
| 1284 | 12B7 | G | No changes. |
| | 14A7 | G | |
| | 14C7 | G | |
| | 14H7 | G | |
| | 1280 | G | |
| 1291 | 3B7 | E | No changes. |
| 1293 | 1LE3 | G | Parallel circuits only. No changes. |
| 1294 | 1R4 | E | No changes. |
| 1299 | 3D6 | E | No changes. |
| 1612 | 6L7 | E | No changes. |
| 1614 | 6L6 | E | No changes. |
| 1619 | 2A5 | G | Reverse 2A5 to 1619 procedure. |
| 1620 | 6J7 | E | No changes. |
| 1626 | 12E5 | G | Parallel circuits only. No changes. |
| | 12J5 | G | |
| 1629 | | | No practical substitute. |
| 1634 | 12SC7 | G | No changes. |
| 1644 | 12L8 | G | No changes. |
| 1654 | | | No practical substitute. |
| 2050 | 2051 | E | No changes. |
| 2051 | 2050 | E | No changes. |
| 5517 | CK1013 | E | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 5517/CK1013 | | | No practical substitute. |
| 5590 | 6AG5 | P | Parallel circuits only. No changes. |
| | 6BC5 | G | |
| | 5591 | G | No changes. |
| | 9001 | G | |
| | 9003 | G | |
| 5591 | 6BC5 | P | Parallel circuits only. No changes. |
| | 6AG5 | G | |
| | 5590 | G | No changes. |
| | 9001 | G | |
| | 9003 | G | |
| 5608-A | 53 | E | No changes. |
| 5618 | 2E30 | G | Parallel circuits only. Rewire as follows: |
| | 5812 | G | Remove wires from No. 4<br>No. 1 to No. 4<br>6 to 1<br>3 to 6<br>7 to 3<br>5 to 7<br>2 to 5<br>Connect wires removed from No. 4 to No. 2. |
| 5635 | | | No practical substitute. |
| 5636 | | | No practical substitute. |
| 5643 | | | No practical substitute. |
| 5646 | | | No practical substitute. |
| 5647 | | | No practical substitute. |
| 5654 | 6AJ5 | G | No changes. |
| | 6AK5 | G | |
| 5670 | 7F8 | G | Where space permits. Same as 2C51 to 7F8. Parallel circuits only. |
| 5672 | 5678 | G | No changes. |
| 5676 | 5677 | P | Parallel circuits only. No changes. |
| 5677 | 5676 | G | Parallel circuits only. No changes. |
| 5678 | 5672 | G | No changes. |
| 5679 | 7A6 | E | Where No. 4 is not used on 5679. No changes. |
| 5686 | | | No practical substitute. |
| 5687 | 6J6 | G | Parallel circuits only. Reverse 6J6 to 5687 procedure. |
| 5691 | 6SL7 | E | Parallel circuits only. No changes. |
| | 6SN7 | P | No changes. |
| | 5692 | P | |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 5692 | 6SN7 | G | No changes. |
| | 5691 | P | |
| 5693 | 6SJ7 | E | No changes. |
| | 6SK7 | P | |
| 5694 | | | No practical substitute. |
| 5697 | | | No practical substitute. |
| 5702 | 5784 | G | No changes. |
| 5703 | 5744 | P | No changes. |
| 5704 | | | No practical substitute. |
| 5718 | 5719 | P | No changes. |
| 5719 | 5718 | P | No changes. |
| 5722 | | | No practical substitute. |
| 5725 | 6AJ5 | P | No changes. |
| | 6AK5 | P | |
| 5726 | 6X4 | G | Parallel circuits only. Rewire as follows:<br>No. 7 to No. 6<br>1 and 5 to 7<br>2 to 1 |
| 5731 | 955 | P | No changes. |
| 5744 | 5703 | P | No changes. |
| 5783 | | | No practical substitute. |
| 5784 | 5702 | G | No changes. |
| 5785 | | | No practical substitute. |
| 5787 | | | No practical substitute. |
| 5812 | 2E30 | G | No changes. |
| 5823 | | | No practical substitute. |
| 5824 | 25A6 | P | No changes. |
| | 25B6 | E | |
| | 25C6 | P | |
| | 25L6 | E | |
| 5840 | 5899 | G | No changes. |
| | 5900 | G | |
| | 5901 | G | |
| 5847 | | | No practical substitute. |
| 5879 | | | No practical substitute. |
| 5896 | | | No practical substitute. |
| 5897 | 5898 | P | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 5898 | 5897 | P | No changes. |
| 5899 | 5840 | G | No changes. |
| | 5900 | G | |
| | 5901 | G | |
| 5900 | 5840 | G | No changes. |
| | 5899 | G | |
| | 5901 | G | |
| 5901 | 5840 | G | No changes. |
| | 5899 | G | |
| | 5900 | G | |
| 5910 | | | No practical substitute. |
| 5915 | 6BE6 | E | No changes. |
| 5931 | | | No practical substitute. |
| 5932 | | | No practical substitute. |
| 9001 | 5590 | P | No changes. |
| | 5591 | G | |
| | 9003 | G | |
| 9002 | 6AB4 | P | Rewire as follows:<br>No. 2 to No. 7<br>5 to 1 |
| 9003 | 5590 | G | No changes. |
| | 9001 | G | |
| 9004 | | | No practical substitute. |
| 9005 | | | No practical substitute. |
| 9006 | | | No practical substitute. |
| X6030 | | | No practical substitute. |
| XXFM | 7X7 | E | No changes. |
| XXL | 6C5 | E | Reverse 6J5 to XXL procedure. |
| | 6J5 | E | Reverse 6J5 to XXL procedure. |
| | 6K7 | E | Reverse 6K7 to XXL procedure. |
| | 7A4 | E | No changes. |

| TUBE. | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6AH6 | 6AC7 | G | Change socket to octal and rewire as follows: |

| No. 1 on miniature | to No. | 4 on octal |
|---|---|---|
| 2 | to | 3 |
| 3 | to | 2 |
| 4 | to | 7 |
| 5 | to | 8 |
| 6 | to | 6 |
| 7 | to | 5 |

Connect pin 1 on octal to common ground on chassis.

| | | | |
|---|---|---|---|
| 6AU6 | 6BJ6 | G | Parallel circuits only. Rewire as follows: Interchange leads between pins 2 and 7. |
| 6T8 | 6AL5 } 6AQ6 } | G | The 6T8 is a triple-diode triode tube. If a 6R8 is not available as a substitute, two tubes can be used if space permits. Of the tube combinations listed here one tube is a double diode (the 6AL5) while the other tubes are double-diode triode types. Of the substitute tubes only those elements necessary to perform the required functions are used. |
| | 6AL5 } 6AT6 } | G | |
| | 6AL5 } 6AV6 } | G | |
| | 6AL5 } 12AV6 } | G | |
| 12AT7 | 7F8 | G | Change socket to loctal and rewire as follows: |

| No. 1 on noval | to No. | 3 on loctal |
|---|---|---|
| 2 | to | 1 |
| 3 | to | 4 |
| 4 | to | 2 |
| 5 | to | 2 |
| 6 | to | 6 |
| 7 | to | 8 |
| 8 | to | 5 |
| 9 | to | 7 |

| | | | |
|---|---|---|---|
| | 6SN7 | G | Change socket to octal and rewire as follows: |

| No. 1 on noval | to No. | 2 on octal |
|---|---|---|
| 2 | to | 1 |
| 3 | to | 3 |
| 4 | to | 7 |
| 5 | to | 7 |
| 6 | to | 5 |
| 7 | to | 4 |
| 8 | to | 6 |
| 9 | to | 8 |

The above filament rewiring applies only if the leads from pins 4 and 5 on the noval are tied together or to the same point.

| | | | |
|---|---|---|---|
| | 12BH7 | G | Parallel circuits only. No changes. |
| 6C6 | 1603 | E | No changes. |
| | 7700 | E | |
| 6F6 | 1611 | E | No changes. |
| 6J7 | 7000 | E | No changes. |

| TUBE | SUB. | PERF. | CIRCUIT CHANGES NECESSARY |
|---|---|---|---|
| 6Y7G | 79 | G | Reverse 6N7 to 79 procedure. |
| 79 | 6Y7G | G | Reverse 6N7 to 79 procedure. |
| 1603 | 6C6 | E | No changes. |
| | 7700 | E | |
| 1611 | 6F6 | E | No changes. |
| 7000 | 6J7 | E | No changes. |
| 7700 | 6C6 | E | No changes. |
| | 1603 | E | |

## IDENTICAL TUBES WITH UNLIKE HEATER VOLTAGE AND CURRENT RATINGS

Substitute high voltage tubes for low voltage tubes in series circuits only with suitable shunt resistor when required. Substitute low voltage tubes for high voltage tubes in parallel circuits with voltage dropping resistor in series with filament -- in series circuits with suitable shunt resistor. For all cases see instructions in Section 1. The performance for each substitution is excellent.

| TUBE | SUB. | TUBE | SUB. | TUBE | SUB. |
|---|---|---|---|---|---|
| 2A3 | 6A3 | 7B6 | 14B6 | 14B8 | 7B8 |
| 2A5 | 42 | 7B8 | 14B8 | 14E6 | 7E6 |
| 2A6 | 75 | 7E6 | 14E6 | 14E7 | 7E7 |
| 2A7 | 6A7 | 7E7 | 14E7 | 14F7 | 7F7 |
| 2B7 | 6B7 | 7F7 | 14F7 | 14F8 | 7F8 |
| 6A3 | 2A3 | 7F8 | 14F8 | 14J7 | 7J7 |
| | 1276 | 7J7 | 14J7 | 14N7 | 7N7 |
| 6A6 | 53 | 7N7 | 14N7 | 14N7 | 7N7 |
| 6A7 | 2A7 | 7Q7 | 14Q7 | 14Q7 | 7Q7 |
| 6A8 | 12A8GT | 7R7 | 14R7 | 14R7 | 7R7 |
| 6B7 | 2B7 | 12A8GT | 6A8 | 25B8GT | 12B8G |
| 6B8 | 12C8 | 12B8G | 25B8GT | 25L6 | 1632 |
| 6F5 | 12F5GT | 12C8 | 6B8 | 30 | RK42 |
| 6H6 | 12H6 | 12F5GT | 6F5 | 42 | 2A5 |
| 6J5 | 12J5GT | 12H6 | 6H6 | 53 | 6A6 |
| 6J7 | 12J7GT | 12J5GT | 6J5 | 55 | 85 |
| 6K7 | 12K7GT | 12J7GT | 6J7 | 56 | 56AS |
| 6K8 | 12K8 | 12K7GT | 6K7 | | 76 |
| 6L6 | 1631 | 12K8 | 6K8 | 56AS | 56 |
| 6Q7 | 12Q7GT | 12Q7GT | 6Q7 | | 76 |
| 6SA7 | 12SA7 | 12SA7 | 6SA7 | 57 | 57AS |
| 6SC7 | 12SC7 | 12SC7 | 6SC7 | 57AS | 57 |
| | 1634 | 12SF5 | 6SF5 | 58 | 58AS |
| 6SF5 | 12SF5 | 12SF7 | 6SF7 | 58AS | 58 |
| 6SF7 | 12SF7 | 12SG7 | 6SG7 | 75 | 2A6 |
| 6SG7 | 12SG7 | 12SH7 | 6SH7 | 76 | 56 |
| 6SH7 | 12SH7 | 12SJ7 | 6SJ7 | 85 | 55 |
| 6SJ7 | 12SJ7 | 12SK7 | 6SK7 | 1276 | 2A3 |
| 6SK7 | 12SK7 | 12SL7GT | 6SL7GT | | 6A3 |
| 6SL7GT | 12SL7GT | 12SN7GT | 6SN7GT | 1631 | 6L6 |
| 6SN7GT | 12SN7GT | | 1633 | 1632 | 25L6 |
| | 1633 | 12SQ7 | 6SQ7 | 1633 | 6SN7GT |
| 6SQ7 | 12SQ7 | 12SR7 | 6SR7 | | 12SN7GT |
| 6SR7 | 12SR7 | 14A4 | 7A4 | 1634 | 6SC7 |
| 7A4 | 14A4 | 14B6 | 7B6 | RK42 | 30 |

# SECTION 3

## TELEVISION RECEIVER FILAMENT CIRCUIT ARRANGEMENT

The filaments of the tubes in most television receivers are either arranged in parallel, series and parallel, or series-parallel circuits. It is necessary to know the filament arrangement of a particular television receiver before some of the tubes in the circuit may be substituted because in many cases, a substitution will involve the addition of a resistor (or other circuit component), or the rearrangement of some part of the filament circuit to make for proper tube operating conditions. For example, the substitution of a tube with a 6.3 volt filament for one with a 12.6 volt filament requires the addition of a series resistor or a shunting resistor depending upon whether the filament is in a parallel or a series circuit respectively. (see Section 1).

In the following section all of the information about filament circuits needed to effect successful substitutions is given for most television receivers. The receivers are listed by model number (or chassis number for those sets having no model number) under the name of the manufacturer. In the second column is found the first page number of the section in the Rider Television Manuals in which all of the servicing information as well as schematics for the set are given. Under "Type Circuit", a "P" indicates that all of the filaments are in parallel chains across the secondaries of the power and/or filament transformers, an "S,P" indicates that some of the filaments are in parallel chains and some are in series circuits across the line or power transformer, and "S-P" indicates that the filaments are in a series-parallel circuit across the line. Where the filament arrangement is either "S,P" or "S-P", the filament circuit is reproduced at the end of this section, and appears with the number shown in the "Schematic" column. The schematics numbered 1-6 are typical of the majority of parallel filament circuits except for the addition of one or two chains similar to those shown. The schematics 7-35 are reproductions of the "S,P", and "S-P" circuits previously referred to.

The number of circuits or chains into which the filaments of any set are divided appears under the "Number of Chains" column. NOTE: The 1B3 high voltage rectifier circuit has not been included in the number of chains since this rectifier in practically all cases comes off the secondary of the horizontal output transformer.

| Model | Rider Man. Page | Type Cir. | No. of Chains | Sch. |
|---|---|---|---|---|
| **ADMIRAL CORP.** | | | | |
| 4H15A, 4H15B, Ch. 20A1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H15S, 4H15SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H16A, 4H16B, Ch. 20A1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H16S, 4H16SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H17A, 4H17B, Ch. 20A1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H18C, 4H18CN, Ch. 20B1; 4K1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H18S, 4H18SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H19C, 4H19CN, Ch. 20B1; 4K1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H19S, 4H19SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H115S, 4H115SN, 4H116S, 4H116SN, 4H117S, 4H117SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H126A, 4H126B, Ch. 21A1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H126C, 4H126CN, Ch. 21A1; 4K1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H126S, 4H126SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H137A, 4H137B, Ch. 21A1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H137S, 4H137SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H145A, 4H145B, Ch. 20B1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H145C, 4H145CN, Ch. 20B1; 4K1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H145S, 4H145SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| **ADMIRAL CORP. (Cont'd)** | | | | |
| 4H146A, 4H146B, Ch. 20B1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H146C, Ch. 20B1; 4K1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H146S, 4H146SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H147A, 4H147B, Ch. 20B1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H147S, 4H147SN, 4H155S, 4H155SN, Ch. 30A1, 30B1, 30C1, 30D1, 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H156C, 4H156CN, Ch. 20B1; 4K1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H156S, 4H156SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H157A, 4H157B, Ch. 20B1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H157S, 4H157SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H165A, 4H165B, Ch. 20B1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H165S, 4H165SN, Ch, 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H166A, 4H166B, Ch. 20B1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H166C, 4H166CN, Ch. 20B1; 4K1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H166S, 4H166SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 4H167A, 4H167B, Ch. 20B1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 4H167C, 4H167CN, Ch. 20B1; 4K1, Radio Ch. | 4-1 | P | 2 | 1 |

| Model | Rider Man. Page | Type Cir. | No. of Chains | Sch. |
|---|---|---|---|---|
| **ADMIRAL CORP. (Cont'd)** | | | | |
| 4H167S, 4H167SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 8C11, Ch. 30A1; 8C1, Radio Ch. | 2-1 | P | 5 | 3 |
| 8C11, 8C11N, 8C11S, 8C11SN, 8C11T, 8C11TN, 8C11UL, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 8C12, Ch. 30A1; 8C1, Radio Ch. | 2-1 | P | 5 | 3 |
| 8C12, 8C12N, 8C12S, 8C12SN, 8C12T, 8C12TN, 8C12UL, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 8C13, Ch. 30A1; 8C1, Radio Ch. | 2-1 | P | 5 | 3 |
| 8C13, 8C13N, 8C13S, 8C13SN, 8C13T, 8C13TN, 8C13UL, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 19A11S, 19A11SN, 19A12S, 19A12SN, 19A15S, 19A15SN, Ch. 19A1 | 3-1 | P | 2 | 1 |
| 20X11, 20X12, 20X122, Ch. 20X1; 4L1, Radio Ch. | 4-38 | P | 2 | 1 |
| 20X136, 20X145, 20X146, 20X147, Ch. 20Y1; 4L1, Radio Ch. | 4-38 | P | 2 | 1 |
| 24A12, 24A125, Ch. 20A1 | 4-1 | P | 2 | 1 |
| 24A125AN, Ch. 20X1; 4L1, Radio Ch. | 4-38 | P | 2 | 1 |
| 24C15, 24C16, Ch. 20B1 | 4-1 | P | 2 | 1 |
| 24X15, 24X15S, 24X16, 24X16S, 24X17S, Ch. 20X1; 4L1, Radio Ch. | 4-38 | P | 2 | 1 |
| 25A15, 25A16, 25A17, Ch. 21A1 | 4-1 | P | 2 | 1 |
| 26X35, 26X36, 26X37, Ch. 24D1; 29X16, 29X17, Ch. 24F1 | 4-1 | P | 3 | 2 |
| 30A12, 30A12N, 30A12S, 30A12SN, 30A12T, 30A12TN, 30A12UL, 30A13, 30A13N, 30A13S, 30A13SN, 30A13T, 30A13TN, 30A13UL, 30A14, 30A14N, 30A14S, 30A14SA, 30A14SN, 30A14T, 30A14TN, 30A14UL, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 30A15 | 1-1 | P | 5 | 3 |
| 30A15, 30A15N, 30A15S, 30A15SA, 30A15SN, 30A15T, 30A15TN, 30A15UL, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 30A16 | 1-1 | P | 5 | 3 |
| 30A16, 30A16N, 30A16S, 30A16SN, 30A16T, 30A16TN, 30A16UL, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 30B15S, 30B15SN, 30B16S, 30B16SN, 30B17S, 30B17SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 30C15S, 30C15SN, 30C16S, 30C16SN, 30C17S, 30C17SN, Ch. 30A1, 30B1, 30C1, 30D1; 4H1, Radio Ch. | 3-17 | P | 5 | 3 |
| 30F15, Ch. 20B1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 30F15A, Ch. 20B1; 4K1, Radio Ch. | 4-1 | P | 2 | 1 |
| 30F16, Ch. 20B1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 30F16A, Ch. 20B1; 4K1, Radio Ch. | 4-1 | P | 2 | 1 |
| 30F17, Ch. 20B1; 4J1, Radio Ch. | 4-1 | P | 2 | 1 |
| 30F17A, Ch. 20B1; 4K1, Radio Ch. | 4-1 | P | 2 | 1 |
| 36X36, 36X37, Ch. 24E1; 39X16, 39X17, Ch. 24G1 | 4-1 | P | 3 | 2 |
| **AFFILIATED RETAILERS, INC.** | | | | |
| AR-TV-10C, AR-TV-12X, AR-TV-12X | 3-1 | P | 3 | 4 |
| AR-23-TV-1 | 3-8 | P | 3 | 2 |
| 16CX, 816, 816CR | 5-1 | P | 3 | 4 |
| **AIR KING PRODUCTS CO., INC.** | | | | |
| A-1000 | 2-1 | P | 3 | 5 |
| A-1001-A, A-2000, A-2001, A-2002 | 3-1 | P | 2 | 1 |
| 12C1, 12T1, 12T2, Ch. 700 | 5-1 | P | 2 | 1 |
| 16C1, Ch. 700-1 | 5-3 | P | 3 | 2 |
| 16C2, Ch. 700-1 | 5-3 | P | 3 | 2 |
| 16K1, Ch. 700-2; 507, Radio Ch. | 5-3 | P | 3 | 2 |
| 16T1, Ch. 700-1 | 5-3 | P | 3 | 2 |
| 712, Ch. 700 | 5-1 | P | 2 | 1 |
| 718R, Ch. 700-1 | 5-3 | P | 3 | 2 |
| **ALLIED PURCHASING CORP. DIV. OF ALLIED STORES** | | | | |
| G-16, V16, 616, 816, Same as Tele-King 616 | 5-1 | P | 3 | 4 |
| 910, Same as Tele-King 510 | 4-1 | P | 3 | 4 |
| 912, Same as Tele-King 512 | 3-1 | P | 3 | 4 |
| 1012, Same as Tele-King 612 | 3-1 | P | 3 | 4 |
| **ALTEC LANSING CORP.** | | | | |
| ALC201 | 3-1 | P | 4 | 6 |
| 202A | 4-1 | P | 3 | 2 |
| 205 | 4-2 | P | 3 | 2 |
| **ANDREA RADIO CORP.** | | | | |
| BCO-VJ12-2, Ch. VJ12-2 | 2-3 | P | 5 | 3 |
| BCO-VJ15, Ch. VJ15 | 2-3 | P | 5 | 3 |
| BT-VK12, Ch. VK12 | 2-8 | P | 5 | 3 |
| C-VJ12, CO-VJ12, Ch. VJ12, CO-VJ12-2, Ch. VJ12-2 | 2-3 | P | 5 | 3 |
| CO-VJ15, Ch. VJ15 | 2-3 | P | 5 | 3 |
| CO-VK15, Corinthian; CO-VK16, Caronia; Ch. VK15-16 | 2-8 | P | 5 | 3 |
| CO-VK16 Late, Caronia, Ch. VK-19 | 2-8 | P | 5 | 3 |
| CO-VK16"C", Dynasty, Ch. VK15-16 | 2-8 | P | 5 | 3 |

| Model | Rider Man. Page | Type Cir. | No. of Chains | Sch. |
|---|---|---|---|---|
| **ANDREA RADIO CORP. (Cont'd)** | | | | |
| CO-VK124, Edgemont, Ch. VK124 | 2-8 | P | 5 | 3 |
| CO-VK125, Ridgeway, Ch. VK12 | 2-8 | P | 5 | 3 |
| CVK19, Normandy, Ch. VK-19 | 2-8 | P | 5 | 3 |
| CVK-126, Gramercy, Ch. VK12 | 2-8 | P | 5 | 3 |
| T-VJ12, Ch. VJ12 | 1-1 | P | 5 | 3 |
| TVK12, Saratoga; TVK-127, Sharron; Ch. VK12 | 2-8 | P | 5 | 3 |
| **ANSLEY RADIO & TELEV., INC.** | | | | |
| 701 | 2-1 | P | 3 | 5 |
| 702, 113 AM-FM, Radio | 2-2 | P | 3 | 5 |
| 717, 718, 725, Ch. P-101 | 4-1 | P | 3 | 5 |
| **ASSOCIATED MERCHANTS CORP.** | | | | |
| AM510, Same as Tele-King 510 | 4-1 | P | 3 | 4 |
| AM712, Same as Tele-King 712 | 4-1 | P | 3 | 4 |
| **THE ASTATIC CORP.** | | | | |
| AT-1, Booster | 4-1 | P | 1 | |
| **ATWATER TELEVISION CO.** | | | | |
| 135, 513 | 5-1 | P | 3 | 2 |
| **AUTOMATIC RADIO MFG. CO., INC.** | | | | |
| AR-TV-709 | 2-1 | S-P | 2 | 7 |
| TV-12-49, TV-12-50 | 4-1 | S-P | 3 | 8 |
| TV-16-49, TV-16-50, TV-16-51 | 3-1 | P | 3 | 2 |
| TV-1205 | 5-5 | S-P | 3 | 8 |
| TV-1205, Series B | 5-1 | P | 1 | |
| TV-1294 | 5-5 | S-P | 3 | 8 |
| TV-1294, Series B | 5-1 | P | 1 | |
| TV-1605, TV-1615 | 5-5 | S-P | 3 | 8 |
| TV-1649, TV-1650, TV-1651, Series B | 5-6 | P | 3 | 2 |
| TV-1694 | 5-5 | S-P | 3 | 8 |
| TV-5001 | 5-2 | P | 1 | |
| TV-5006 | 5-2 | P | 1 | |
| TV-5012 | 5-2 | P | 1 | |
| TV-5061, TV-5077 | 5-2 | P | 1 | |
| TV-5111 | 5-2 | P | 1 | |
| **BACE TELEVISION CORP.** | | | | |
| 16 RCC, 16 RCH, 19 RCC, 19 RCH | 4-1 | P | 5 | 3 |
| 150-D | 2-1 | P | 5 | 1&5 |
| 160C | 2-1 | P | 3 | 5 |
| 160-K | 2-1 | P | 3 | 5 |
| 160TM | 2-1 | P | 3 | 5 |
| 190-K, 190-KFD, 190KHD | 2-1 | P | 3 | 5 |
| **BAGDAD TELEVISION CO., INC.** | | | | |
| 19 Tube Set | 2-1 | P | 2 | 1 |
| **BELL TELEVISION, INC.** | | | | |
| 16DD, 16T, 16TD, 19DD, 19T, 19TD, 1502, 1503, 2002, 2003 | 4-1 | P | 3 | 5 |
| **BELMONT RADIO CORP. (RAYTHEON)** | | | | |
| Coronet | 3-1 | S-P | 9 | 10 |
| Observer | 3-1 | S-P | 3 | 9 |
| A-7DX22-P, Series A | 4-1 | S-P | 3 | 9 |
| A-10DX22, Observer; A-10DX24, Ch. A, B, C, D; Radio Ch. | 3-1 | S-P | 6 | 10 |
| B-10DX22, Ch. A, B, C, D; Radio Ch. | 3-1 | S-P | 6 | 10 |
| C-1102, Ch. 12AX22 | 4-6 | P | 2 | 1 |
| C-1104B, Ch. 12AX27 | 5-1 | P | 3 | 2 |
| C-1401, Ch. 14AX21 | 5-9 | P | 3 | 2 |
| C-1602, Ch. 16AX23, 16AX25, 16AX26 | 5-21 | P | 2 | 1 |
| 7DX21 | 2-6 | S-P | 3 | 9 |
| 7DX21, Series B | 2-6 | S-P | 3 | 9 |
| 10AXF43, Ch. A, B, C, D; Radio Ch. | 3-1 | S-P | 3 | 9 |
| 10DX21, Ch. A, B, C, D; Radio Ch. | 2-1 | S-P | 6 | 10 |
| 10DX22, 10DX24, Coronet, Ch. A, B, C, D; Radio Ch. | 31-1 | S-P | 6 | 10 |
| 18DX21 | 2-6 | S-P | 3 | 9 |
| 18DX21A | 2-6 | S-P | 3 | 9 |
| 21A21 | 1-1 | P | 2 | 1 |
| 22A21, 22AX21, 22AX22 | 1-25 | P | 2 | 1 |
| **BENDIX RADIO DIV.** | | | | |
| 235B1 | 2-1 | P | 2 | 1 |
| 235B1, Codes A, B, C, D, E, F, G, H, I, J, K, L, M, MA, MB, MC, MD | 3-1 | P | 2 | 1 |
| 23M1 | 2-1 | P | 2 | 1 |
| 325M8, Codes A, B, C, D, E, F, G, H, I, J, K, L, M, MA, MB, MC, MD | 3-1 | P | 2 | 1 |
| 2001, 2002, 2020, 2021; 2000 Series | 3-21 | P | 3 | 2 |
| 2025 | 4-1 | P | 3 | 2 |
| 2051 | 5-1 | P | 3 | 2 |
| 3001, 3002, 3030, 3031; 3000 Series | 3-21 | P | 3 | 2 |
| 3033 | 4-1 | P | 3 | 2 |

| Model | Rider Man. Page | Type Cir. | No. of Chains | Sch. |
|---|---|---|---|---|
| **BENDIX RADIO DIV. (Cont'd)** | | | | |
| 3051, 6001 | 5-1 | P | 3 | 2 |
| 6002 | 4-1 | P | 3 | 2 |
| 6003 | 5-1 | P | 3 | 2 |
| 6100 | 5-1 | P | 3 | 2 |
| **BRUNSWICK** See RADIO & TELEVISION INC. | | | | |
| **BUD RADIO CO.** | | | | |
| TAB-98, Booster | 2-1 | P | 1 | |
| TAB-99, PreAmp | 2-1 | P | 1 | |
| **CALBEST ENGINEERING & ELECTRONICS CO.** | | | | |
| 5082, 5086, 5086R, 5089, 5089R | 5-1 | P | 3 | 2 |
| **CAPEHART-FARNSWORTH CORP.** Also See FARNSWORTH TELEV. & RADIO CORP | | | | |
| 3001-B, 3001-M, 3002-B, 3002-M, Ch. C-272; Ch. CX-30 | 4-1 | S,P | 3 | 15 |
| 3004-M, Ch. C-268; 3006-M, Ch. C-274; CX-31 | 4-17 | P | 3 | 2 |
| 3007-M, Ch. C-276; Ch. CX-30 | 4-1 | S,P | 3 | 15 |
| 3011-B, 3011-M, 3012-B, 3012-M, Ch. C-281; Ch. CX-33 | 5-1 | P | 2 | 1 |
| 4001-M, Ch. C-268; 4002-M, Ch. C-274; Ch. CX-31 | 4-17 | P | 3 | 2 |
| **CERTIFIED RADIO LABORATORIES** | | | | |
| 47-71 | 1-1 | P | 3 | 2 |
| 48-10 | 1-1 | P | 3 | 2 |
| 49-10 | 2-1 | P | 3 | 2 |
| 49-710 | 2-1 | P | 3 | 2 |
| 4920 | 4-1 | P | 4 | 6 |
| **CERTIFIED TELEVISION LABORATORIES** See CERTIFIED RADIO LABORATORIES | | | | |
| **CLEERVUE TELEVISION CORP.** | | | | |
| Hollywood, Regency | 1-1 | P | 3 | 5 |
| **CONSOLIDATED TELEVISION CORP.** Also See TELE-KING CORP. | | | | |
| 2315 | 1-1 | P | 1 | |
| **CORNELL TELEVISION, INC.** See VIDEO CORP. OF AMERICA | | | | |
| **CROSLEY DIV. AVCO MFG. CORP.** | | | | |
| 9-403M, 9-403MA, 9-403M-2 | 3-1 | P | 4 | 6 |
| 9-404M | 4-1 | P | 4 | 6 |
| 9-407, 9-407M, 9-407-1, 9-407M-2, 9-407M-3 | 2-1 | P | 2 | 2 |
| 9-409M3-LD | 4-13 | P | 3 | 2 |

| Model | Rider Man. Page | Type Cir. | No. of Chains | Sch. |
|---|---|---|---|---|
| **CROSLEY DIV. AVCO MFG. CORP. (Cont'd)** | | | | |
| 9-413B, 9-413B-2 | 3-1 | P | 4 | 6 |
| 9-414B | 4-1 | P | 4 | 6 |
| 9-419M1-LD, 9-419M3-LD | 4-26 | P | 3 | 2 |
| 9-420M | 4-38 | P | 4 | 6 |
| 9-422M, 9-422MA | 4-47 | P | 3 | 2 |
| 9-422M-LD | 5-1 | P | 3 | 2 |
| 9-423M | 4-59 | P | 4 | 6 |
| 9-423M-LD | 5-14 | P | 4 | 6 |
| 9-424B | 4-38 | P | 4 | 6 |
| 9-425 | 3-9 | P | 3 | 4 |
| 10-401 | 5-25 | P | 3 | 4 |
| 10-414MU, 10-416MU, 10-416M1U | 5-37 | P | 4 | 6 |
| 10-419MU | 5-42 | P | 3 | 4 |
| 307TA, 307TA-50 | 1-1 | P | 3 | 5 |
| 348CP, Ch. TR1, TR2, TR3 | 2-15 | P | 3 | 6 |
| **THE DENMAR TELEVISION CO.** | | | | |
| 630-HV | 3-1 | P | 3 | 6 |
| **DE WALD RADIO MFG. CORP.** | | | | |
| BT-100, BT-101 | 2-1 | P | 3 | 5 |
| CT-101 | 3-1 | P | 3 | 5 |
| CT-102, CT-103, CT-104 | 3-2 | P | 5 | 3 |
| DT-120 | 4-1 | P | 5 | 3 |
| DT-161 | 4-1 | P | 5 | 3 |
| DT-1020, DT-1030, DT-X-160 | 4-1 | P | 5 | 3 |
| **ALLEN B. DUMONT LABORATORIES, INC.** | | | | |
| Inputuner | 1-1 | P | 1 | |
| RA-101, Devonshire, Hampshire, Plymouth, Revere, Sherwood, Westminster | 1-7 | P | 6 | 4&5 |
| RA-101-B | 2-1 | P | 6 | 2&5 |
| RA-102, RA-102-B1, RA-102-B2, RA-102-B3, Clifton, Club | 1-34 | P | 3 | 5 |
| RA-103, Chatham, Savoy | 1-58 | P | 3 | 2 |
| RA-103-D, Canterbury, Rumson, Sheffield; RA-104-A, Hastings, Wellington | 3-1 | P | 4 | 6 |
| RA-105, Colony, Stratford, Westbury, Whitehall | 2-5 | P | 4 | 5 |
| RA-105-B, Sussex | 4-5 | P | 4 | 5 |
| RA-106, Club 20 | 2-34 | P | 4 | 5 |
| RA-108-A, Bradford, Mansfield | 4-5 | P | 5 | 5&1 |

| Model | Rider Man. Page | Type Cir. | No. of Chains | Sch. |
|---|---|---|---|---|
| **ALLEN B. DUMONT LABORATORIES, INC. (Cont'd)** | | | | |
| RA-110-A, Fairfield, Westwood | 3-1 | P | 4 | 6 |
| **DYNAMIC TELEV. ASSOCIATES, INC.** | | | | |
| TU-10C | 2-1 | P | 3 | 2 |
| **ELECTROMATIC MFG. CORP.** | | | | |
| 101, 120-A | 5-1 | S-P | 3 | 11 |
| **ELECTRO-TECHNICAL INDUSTRIES (TELEKIT)** | | | | |
| 7 Telekit | 1-1 | P | 3 | 2 |
| 7-A | 2-1 | P | 4 | 6 |
| 7B | 3-1 | P | 4 | 6 |
| 10 Telekit | 1-23 | P | 6 | 3 |
| 10-A | 2-11 | P | 4 | 5 |
| 10B | 4-8 | P | 4 | 6 |
| 13B-KT Tuner; 16CK, Conversion Kit | 4-14 | P | 1 | |
| **EMERSON RADIO & PHONO. CORP.** | | | | |
| 527, Ch. 120019 | 1-1 | P | 3 | 4 |
| 545, Ch. 120047 | 1-8 | P | 3 | 2 |
| 571, Ch. 66B | 2-1 | S-P | 3 | 12 |
| 571, Ch. 86B | 2-1 | S,P | 3 | 12 |
| 585, Ch. 120025B, 120088B; 120024B, 120081B, Radio Ch. | 3-1<br>3-11 | S,P<br>S | 3<br>1 | 12 |
| 600, Ch. 120103B | 4-1 | S-P | 3 | 13 |
| 606, Ch. 66B | 2-1 | S-P | 3 | 12 |
| 606, Ch. 86B | 2-1 | S,P | 3 | 12 |
| 608, Ch. 120089B | 3-19 | P | 3 | 4 |
| 611, Ch. 87B | 2-1 | P | 2 | 1 |
| 614, Ch. 120110B, 120110C | 4-9 | P | 3 | 4 |
| 618, Ch. 120090B, 120090D; 120081B, Radio Ch. | 3-1<br>3-11 | P<br>S | 2<br>1 | 1 |
| 621, Ch. 120098B; 622, Ch. 120098P | 4-21 | P | 3 | 4 |
| 626, Ch. 120104B, 120104BJ | 3-19 | P | 2 | 1 |
| 628, Ch. 120098B | 4-21 | P | 3 | 4 |
| 629D, Ch. 120124B | 5-27 | P | 3 | 4 |
| 630, Ch. 120099B | 4-21 | P | 3 | 4 |
| 631, Ch. 120109B; 632, Ch.120096B; 633, Ch. 120114B | 5-6 | P | 3 | 4 |
| 637, Ch. 120110B, 120110C | 4-9 | P | 3 | 4 |
| 639, Ch. 120103B | 4-1 | S-P | 3 | 13 |
| 644, 647, Ch. 120113B, 120113C | 4-9 | P | 3 | 4 |
| 648B, Ch. 120110-E | 4-9 | P | 3 | 4 |
| 650, Ch. 120113B, 120113C | 4-9 | S,P | 4 | 14 |
| **EMERSON RADIO & PHONO. CORP. (Cont'd)** | | | | |
| 651D, 658B, Ch. 120124B | 5-27 | P | 3 | 4 |
| 470606, Tuner | 5-1 | P | 1 | |
| **ESPEY MFG. CO., INC.** | | | | |
| 3-Inch Kit | 1-1 | P | 3 | 2 |
| **FADA RADIO & ELECTRIC CO., INC.** | | | | |
| R-1025, R-1050 | 5-1 | P | 3 | 5 |
| TV-30 | 2-1 | P | 3 | 5 |
| 799 | 2-1 | P | 3 | 5 |
| 880 | 3-1 | P | 3 | 5 |
| 895; 891, Radio Ch. | 4-7 | P | 3 | 5 |
| 899 | 2-1 | P | 3 | 5 |
| 925 | 4-1 | P | 3 | 5 |
| 930, 940 | 3-20 | P | 3 | 5 |
| 965 | 4-1 | P | 3 | 5 |
| **FARNSWORTH TELEV. & RADIO CORP.** Also See CAPEHART-FARNSWORTH CORP. | | | | |
| GV-260 | 1-1 | P | 4 | 3 |
| U-12-A, Capehart | 2-9 | P | 3 | 2 |
| 504P16, Ch. U-12 | 2-9 | P | 3 | 2 |
| 651-P | 2-1 | P | 4 | 3 |
| 661-P | 2-1 | P | 4 | 3 |
| **FEDERAL TELEVISION CORP.** | | | | |
| 1501TV | 4-1 | P | 3 | 2 |
| **FEDERAL VIDEO CORP.** | | | | |
| 209, 309, 409, Ch. 31 | 3-1 | P | 3 | 5 |
| **FERGUSON RADIO, INC.** | | | | |
| 749PTV, 749TV | 3-1 | S-P | 3 | 16 |
| 1049TVT | 3-2 | P | 3 | 2 |
| **THE FIRESTONE TIRE & RUBBER CO.** | | | | |
| 13-G-3 | 3-1 | S-P | 2 | 17 |
| 13-G-4 | 4-1 | P | 4 | 6 |
| 13-G-5 | 3-5 | P | 4 | 3 |
| 13-G-33 | 4-6 | S-P | 2 | 17 |
| **FREED-EISEMANN** See FREED RADIO CORP. | | | | |
| **FREED RADIO CORP. (FREED-EISEMANN)** | | | | |
| 55, Ch. 1620C | 5-1 | P | 4 | 5 |
| 56, Ch. 1620 | 3-1 | P | 4 | 5 |
| 77, Ch. 1610 | 3-1 | P | 4 | 5 |

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| **GAMBLE- SKOGMO, INC.** | | | | |
| FA43-8965A, FA43-8965B | 3-1 | S-P | 3 | 9 |
| FA43-8966 | 4-1 | S-P | 6 | 10 |
| TV43-8908 | 4-15 | P | 3 | 2 |
| TV43-8960 | 3-10 | P | 3 | 2 |
| 94TV1-43-8940A | 4-21 | P | 2 | 1 |
| 94TV2-43-8970A, 94TV2-43-8971A | 3-17 | P | 4 | 6 |
| 94TV6-43-8953A | 5-9 | P | 3 | 2 |
| **GAROD RADIO CORP.** | | | | |
| 10TZ20, Ambassador; 10TZ21, Malibu; 10TZ22, Monticello; 10TZ23, Catalina | 4-5 | P | 4 | 6 |
| 12TZ20, Belvedere; 12TZ21, Claridge; 12TZ22, Caronet; 12TZ23, Carlton | 4-5 | P | 4 | 6 |
| 15TZ24, 15TZ25, 15TZ26, 15TZ27 | 4-5 | P | 4 | 6 |
| 19C6, 19C7 | 5-18 | P | 3 | 4 |
| 900 Series | 2-1 | P | 4 | 6 |
| 1000 | 2-1 | P | 4 | 6 |
| 1042G | 3-7 | P | 3 | 4 |
| 1042T | 4-10 | P | 3 | 4 |
| 1043G | 3-7 | P | 3 | 4 |
| 1043T | 4-10 | P | 3 | 4 |
| 1100 | 2-1 | P | 4 | 6 |
| 1142 | 4-1 | P | 3 | 4 |
| 1143 | 4-1 | P | 3 | 4 |
| 1200 | 2-1 | P | 4 | 6 |
| 1244T | 4-10 | P | 3 | 4 |
| 1245T | 4-10 | P | 3 | 4 |
| 1344 | 4-1 | P | 3 | 4 |
| 1345 | 4-1 | P | 3 | 4 |
| 1546T | 4-10 | P | 3 | 4 |
| 1547T | 4-10 | P | 3 | 4 |
| 1548T | 4-10 | P | 3 | 4 |
| 1549T | 4-10 | P | 3 | 4 |
| 1646 | 4-1 | P | 3 | 4 |
| 1647 | 4-1 | P | 3 | 4 |
| 1648 | 4-1 | P | 3 | 4 |
| 1649 | 4-1 | P | 3 | 4 |
| 1671 | 5-15 | P | 3 | 4 |
| 1672, 1673, 1674, 1675, 1974, 1975 | 5-18 | P | 3 | 4 |
| 2042T | 4-10 | P | 3 | 4 |

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| **GAROD RADIO CORP. (Cont'd)** | | | | |
| 2043T | 4-10 | P | 3 | 4 |
| 2546T | 4-10 | P | 3 | 4 |
| 2547T | 4-10 | P | 3 | 4 |
| 2548T | 4-10 | P | 3 | 4 |
| 2549T | 4-10 | P | 3 | 4 |
| 3912TVFMP; 11FMT, Radio | 1-1 | P | 4 | 6 |
| 3915TVFMP; 9FMT, Radio | 2-12 | P | 4 | 6 |
| **GENERAL ELECTRIC CO.** | | | | |
| HM-171 | 1-1 | P | 3 | 2 |
| HM-185 | 1-3 | P | 3 | 2 |
| HM-225, HM-225B | 1-14 | P | 2 | 1 |
| HM-226B, HM-226-7A | 1-14 | P | 2 | 1 |
| 10C101, 10C102, 10T1, 10T4, 10T5, 10T6 | 5-1 | S-P | 2 | 19 |
| 12C101, 12C102, 12C105 | 5-25 | S-P | 2 | 19 |
| 12C107, 12C108, 12C109 | 5-35 | S-P | 2 | 20 |
| 12C107, 12C108, 12C109, B Version | 5-35 | S-P | 2 | 20 |
| 12K1 | 5-12 | S-P | 2 | 19 |
| 12T1 | 5-25 | S-P | 2 | 19 |
| 12T3, 12T4 | 5-35 | S-P | 2 | 20 |
| 12T3, 12T4, B Version | 5-35 | S-P | 2 | 20 |
| 800A, 800B, 800C, 800D | 4-1 | S-P | 2 | 18 |
| 801, Early, Late | 1-28 | P | 3 | 2 |
| 802 | 1-52 | P | 4 | 6 |
| 803 | 2-1 | P | 4 | 6 |
| 805, Early, S, T, U, W, Versions | 3-1 | S-P | 2 | 18 |
| 806, 807, Early, S, T, U, W, Versions | 3-1 | S-P | 2 | 18 |
| 809, Early, S, T, U, W, Versions | 3-1 | S-P | 2 | 18 |
| 810 | 2-11 | P | 5 | 5 |
| 811 | 2-11 | P | 5 | 5 |
| 814 | 2-22 | P | 5 | 5 |
| 817, S, T, U, W, Versions | 4-9 | S-P | 2 | 18 |
| 818 | 4-24 | S-P | 2 | 18 |
| 820 | 3-16 | P | 5 | 5 |
| 821, S, T, U, W, Versions | 4-9 | S-P | 2 | 18 |
| 830, Early, R, T, Versions | 3-31 | P | 5 | 5 |
| 835, Early, R, Versions | 3-45 | P | 4 | 5 |
| 840 | 4-34 | P | 5 | 5 |
| 901, Preliminary | 1-73 | P | 5 | 3 |

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| **GENERAL ELECTRIC CO. (Cont'd)** | | | | |
| 901, Final | 2-32 | P | 5 | 3 |
| 910, Preliminary | 1-73 | P | 5 | 3 |
| 910, Final | 2-32 | P | 5 | 3 |
| **GENERAL INSTRUMENT CORP.** | | | | |
| TVA | 3-1 | P | 1 | |
| TVB | 2-1 | P | 1 | |
| TVB Revised, TVC | 3-1 | P | 1 | |
| 44, Revised | 5-1 | P | 1 | |
| 44TV, Tuner | 4-1 | P | 1 | |
| **GILFILLAN BROS., INC.** | | | | |
| 339-59A | 1-1 | P | 3 | 2 |
| **GUTHMAN INTERNATIONAL CORP.** | | | | |
| 34-1024, Tuner | 3-1 | P | 1 | |
| **THE HALLICRAFTERS CO.** | | | | |
| T-54 | 1-1 | S-P | 2 | 21 |
| T-60 | 4-1 | P | 3 | 2 |
| T-68 | 4-1 | P | 3 | 2 |
| 505 | 1-1 | S-P | 2 | 21 |
| 515 | 3-8 | P | 3 | 2 |
| 600, 601, 602 | 4-18 | P | 3 | 2 |
| 716, 717, 730, 731, 740, 741, Ch. C919120 | 5-1 | P | 3 | 2 |
| **HOFFMAN RADIO CORP.** | | | | |
| CT-800, CT-801, CT-900, CT-901 | 2-1 | P | 3 | 5 |
| 610, Ch. 140 | 3-1 | P | 3 | 2 |
| 612, Ch. 142 | 3-1 | P | 3 | 2 |
| 820, 821, 822, Ch. 146; 826, 827, 828, Ch. 143 | 3-1 | P | 3 | 2 |
| 912, 913, Ch. 147 | 3-1 | P | 3 | 2 |
| **HOWARD RADIO CO.** | | | | |
| 475-TV | 2-1 | P | 3 | 5 |
| **I.D.E.A.** See INDUSTRIAL DEVELOPMENT ENG. ASSOCIATES, INC. | | | | |
| **INDUSTRIAL DEVELOPMENT ENG. ASSOCIATES, INC. (I.D.E.A.)** | | | | |
| Regency | 4-1 | P | 1 | |
| DB-213, Regency | 4-1 | P | 1 | |
| **INDUSTRIAL TELEV., INC.** | | | | |
| IT-1R | 1-1 | P | 6 | 2&5 |
| IT-3R | 1-11 | P | 7 | 4&6 |
| IT-11R | 2-1 | P | 4 | 6 |
| IT-13R | 2-1 | P | 4 | 6 |
| IT-15R, Guest Television | 2-4 | P | 2 | 1 |
| IT-21R, IT-21R-1, IT-21R-2, Ch. | 4-1 | P | 3 | 4 |
| IT-22R | 2-6 | P | 3 | 2 |
| IT-26R | 3-1 | P | 7 | 2&6 |
| IT-35R | 3-1 | P | 7 | 2&6 |
| IT-39R, IT-40R, IT-42R, IT-46R | 3-1 | P | 7 | 2&6 |
| IT-48R-1-2-3-4 | 5-1 | P | 3 | 2 |
| 326 | 3-1 | P | 7 | 2&6 |
| 721, 821, 921, 1021 | 4-1 | P | 3 | 4 |
| **INTERNATIONAL TELEV. CORP.** | | | | |
| D16 | 3-1 | P | 3 | 5 |
| E-16 | 4-1 | P | 2 | 1 |
| **INTERSTATE STORES BUYING CORP. (PLYMOUTH)** | | | | |
| IS510, Same as Tele-King 510 | 4-1 | P | 3 | 4 |
| IS812, Same as Tele-King 512 | 3-1 | P | 3 | 4 |
| 250, 350, 750 | 5-1 | P | 3 | 2 |
| **JACKSON INDUSTRIES, INC.** | | | | |
| 5000TV, 5050CTV, 5200TV, 5250CTV, 5600TV, 5650CTV | 3-1 | P | 2 | 1 |
| **JAMAICA RADIO TELEV. MFG. CO.** | | | | |
| RTP | 3-1 | P | 2 | 1 |
| WBS, DeLuxe | 3-2 | P | 2 | 1 |
| **JERROLD ELECTRONICS CORP.** | | | | |
| TV-FM, Booster | 2-1 | P | 1 | |
| TV-FM, Series B, Booster | 3-1 | P | 1 | |
| **KAYE-HALBERT** See TELINDUSTRIES, INC. | | | | |
| **MACY'S** | | | | |
| Bryant, Classic, Corner Cab, Queen Anne, Regency, Trafalgar; Same as Shevers 032-16 | 5-1 | P | 3 | 5 |
| 1016, 1019, Queen Anne; 2016, 2019, Regency; 3016, 3019, Trafalgar; 4016, 4019, Classic; 5016, 5019, Bryant; 6016, 6019, Corner Cab; Same as Shevers 032-16 | 5-1 | P | 3 | 5 |
| **THE MAGNAVOX CO.** | | | | |
| CT-214A | 2-1 | P | 3 | 2 |
| CT-214B | 2-1 | P | 3 | 2 |
| CT-218 | 2-1 | P | 3 | 2 |
| CT-219, CT-220 | 3-1 | P | 3 | 2 |

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| **THE MAGNAVOX CO. (Cont'd)** | | | | |
| CT-221 | 2-1 | P | 3 | 2 |
| CT-222 | 3-1 | P | 3 | 2 |
| CT-224, CT-235 | 4-1 | P | 2 | 1 |
| CT-237, CT-238 | 3-1 | P | 3 | 2 |
| MCT 228 | 4-14 | P | 3 | 2 |
| **MAJESTIC RADIO & TELEV. CORP.** | | | | |
| 7TV850, Ch. 18C90 | 3-1 | P | 2 | 1 |
| **MAJESTIC RADIO AND TELEVISION, INC.** | | | | |
| 19C6, 19C7, 1672, 1673, 1674, 1675, 1974, 1975 | 5-12 | P | 3 | 4 |
| **MARS TELEVISION INC.** | | | | |
| 1200 | 2-1 | P | 3 | 5 |
| **MASCO** See MARK SIMPSON MFG. CO., INC. | | | | |
| **JOHN MECK INDUSTRIES, INC.** | | | | |
| XA-701, XB-702, XC-703 | 3-1 | S-P | 3 | 16 |
| XL-750 | 3-1 | P | 3 | 2 |
| XM-751, XN-752, XO-774, XQ-776, XR-778, XS-786, XT-785 | 4-1 | P | 3 | 4 |
| **MEISSNER MFG. DIV. MAGUIRE INDUSTRIES, INC.** | | | | |
| 24TV | 2-1 | P | 3 | 2 |
| 25TV | 4-1 | P | 3 | 2 |
| **MERRICK TELEVISION CO.** | | | | |
| Visionmaster | 2-1 | P | 4 | 6 |
| **MIDWEST RADIO & TELEV. CORP.** | | | | |
| JR-32, Ch. CJ-32, CR-30 | 4-11 | P | 2 | 1 |
| JX-26, JXA-24, Ch. CX-26, CXA-24 | 4-5 | P | 2 | 1 |
| MX-22, MXA-20, Ch. CM-22, CMA-20 | 4-1 | P | 2 | 1 |
| TRC-12, Ch. TR12 | 4-16 | P | 4 | 6 |
| XA-12, Ch. CA-12; XT-12, Ch. CT-12 | 3-1 | P | 4 | 5 |
| 932, Ch. CA-12; 936, Ch. CT-12 | 3-1 | P | 3 | 2 |
| 945, Ch. TR12 | 4-16 | P | 3 | 2 |
| **MITUS, INC.** | | | | |
| Master No. 2 System | 1-1 | P | 5 | 3 |
| **MONTGOMERY WARD** | | | | |
| 84GSE-3011A | 4-1 | P | 3 | 4 |
| 84HA-3002A | 3-1 | S-P | 3 | 25 |
| 84HA-3002B | 3-6 | S-P | 3 | 25 |
| 84HA-3007A, 84HA-3007B, 84HA-3007C | 4-7 | P | 3 | 2 |
| 84HA-3010A, 84HA-3010B, 84HA-3010C | 5-1 | P | 3 | 2 |
| 94BR-3004, 94BR-3004C, 94BR-3004D, 94BR-3005, 94BR-3005C | 5-10 | S-P | 3 | 9 |
| 94BR-3004E | 5-10 | S-P | 3 | 10 |
| 94BR-3017A | 3-11 | S-P | 3 | 9 |
| 94BR-3021A, 94BR-3024A, Code 1 | 4-17 | P | 2 | 1 |
| 94GSE-3015A | 4-22 | P | 3 | 4 |
| 94GSE-3018A | 5-29 | P | 3 | 4 |
| 94GSE-3025A, 94GSE-3033A | 5-38 | P | 4 | 3 |
| 94WG-3022A, 94WG-3026A, 94WG-3026B, 94WG-3026B, 94WG-3029A, 94WG-3029B | 4-38 | P | 4 | 6 |
| **MOTOROLA INC.** | | | | |
| VF102, VF102-A, VF102-C, Ch. TS-7; HS-108, Radio Ch. | 2-1 | P | 5 | 3 |
| VF103, VF103M, Ch. TS-8 | 4-1 | P | 5 | 6 |
| VK101, Early, Late, Ch. TS-3 | 1-53 | P | 5 | 3 |
| VK106, Ch. TS-9, TS-9B, Revised | 2-27 | S, P | 3 | 12 |
| VK106, Ch. TS-9A, TS-9B, TS-9D | 3-1 | P | 4 | 6 |
| VK106B, VK106M, Ch. TS-9, TS-9B | 3-1 | S, P | 3 | 12 |
| VK106B, VK106M, Ch. TS-9B, TS-9C, TS-9D | 3-1 | P | 4 | 6 |
| VT71, Ch. TS-4 | 1-1 | S-P | 3 | 22 |
| VT71, Ch. TS-4B, TS-4C, TS-4D, TS-4E, TS-4F, TS-4G, TS-4H, TS-4J | 2-34 | S-P | 3 | 24 |
| VT105, Ch. TS-9A, TS-9C, TS-9D | 3-1 | P | 4 | 6 |
| VT105M, Ch. TS-9, TS-9B; Revised | 2-27 | S, P | 3 | 12 |
| VT105M, Ch. TS-9A, TS-9C; TS-9D | 3-1 | P | 4 | 6 |
| VT107, Ch. TS-9, TS-9B; Revised | 2-27 | S, P | 3 | 12 |
| VT107, Ch. TS-9A, TS-9C; TS-9D | 3-1 | P | 4 | 6 |
| VT107M, Ch. TS-9, TS-9B; Revised | 2-27 | S, P | 3 | 12 |
| VT107M, Ch. TS-9A, TS-9C; TS-9D | 3-1 | P | 4 | 6 |
| VT121, Ch. TS-15, TS-15A, TS-15B, TS-15C, TS-15C1 | 3-26 | P | 5 | 6 |
| 7VT1, 7VT2, 7VT5, Ch. TS-18, TS-18A | 4-11 | S-P | 3 | 26 |
| 10T2, Ch. TS-14B | 4-19 | P | 3 | 4 |
| 10VK9, 10VT3, Ch. TS-9E, TS-9D1 | 3-18 | P | 4 | 6 |
| 10VK12, 10VK12R, 10VK22R, 10VT10, 10VT10B, 10VT10R, 10VT24R, Ch. TS-14, TS-14A, TS-14B | 4-19 | P | 3 | 4 |
| 12K1, 12K1B, 12K2, 12K2B, 12T1, 12T1B, Ch. TS-23B | 4-19 | P | 3 | 4 |
| 12VF4B, 12VF4R, 12VF4R-C, Ch. TS-23, TS-23A | 4-19 | P | 3 | 4 |

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| 12VK11, 12VK11B, 12VK11R, Ch. TS-23, TS-23A, TS-23B | 4-19 | P | 3 | 4 |
| 12VK15B, 12VK15R, Ch. TS-30, TS-30A | 5-8 | P | 3 | 4 |
| 12VT13, 12VT13B, 12VT13R, Ch. TS-23, TS-23A, TS-23B | 4-19 | P | 3 | 4 |
| 16K2L, 16K2LB, Ch. TS-52 | 4-19 | P | 3 | 4 |
| 16VK1B, 16VK1R, Ch. TS-52 | 4-19 | P | 3 | 4 |
| 16VK7B, 16VK7R, Ch. TS-16, TS-16A | 4-30 | P | 3 | 4 |
| 19F1, 19F1B, 19K1, Ch. TS-67, TS-67A | 5-22 | P | 3 | 4 |
| **MULTIPLE TELEV. MFG. CO.** | | | | |
| M-1500, M-2000 | 2-1 | P | 4 | 5 |
| MR-1500, MR-2000 | 2-2 | P | 4 | 5 |
| MT-1250 | 2-1 | P | 4 | 5 |
| **MUNTZ T-V, INC.** | | | | |
| M-12, Ch. M-158 | 3-1 | P | 3 | 4 |
| M-20, M-21, M-22, Ch. M-159-A | 3-2 | P | 3 | 4 |
| M30, Ch. TV16A1; M31, Ch. TV16A2; M31R, M32, Ch. TV16A3 | 5-1 | P | 3 | 4 |
| M-159, Ch. | 4-1 | P | 3 | 4 |
| M-159-B, Ch. | 3-3 | P | 3 | 4 |
| M-169, Ch. | 3-4 | P | 3 | 4 |
| M-169, Ch., Revised | 4-2 | P | 3 | 4 |
| **NATIONAL CO., INC.** | | | | |
| NC-TV-7, NC-TV-7M, NC-TV-7W; | 2-1 | S-P | 2 | 23 |
| 1st Revision | 3-1 | S-P | 2 | 23 |
| 2nd Revision | 3-3 | P | 4 | 6 |
| NC-TV-10C | 4-1 | P | 4 | 6 |
| NC-TV-10T | 4-1 | P | 4 | 6 |
| TV-1001, TV-1025 | 4-1 | P | 4 | 6 |
| TV-1201 | 5-3 | P | 4 | 6 |
| TV-1226, TV-1601, TV-1625 | 5-3 | P | 4 | 6 |
| **NEW ENGLAND TELEV. CO.** | | | | |
| Custom Console | 2-1 | P | 4 | 6 |
| **THE NIELSEN TELEV. CORP.** | | | | |
| 1018 | 2-1 | P | 3 | 5 |
| 1618 | 4-1 | P | 3 | 5 |
| **NORELCO** | | | | |
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| **NORTH AMERICAN PHILLIPS CO., INC. (NORELCO)** | | | | |
| 160, Protelgram | 3-1 | P | 1 | |
| **OLYMPIC RADIO & TELEV. INC.** | | | | |
| DX-214, DX-215, DX-216, Serial No. H-200,001 to H-205,000 | 4-1 | P | 3 | 2 |
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| TV-104, Cruzair; TV-105, TV-106, Challenger; TV-107, Pacemaker; TV-108, DeLuxe Ten | 3-1 | P | 3 | 2 |
| TV-922 | 2-1 | P | 4 | 6 |
| TV-922L, DeLuxe Ten | 3-1 | P | 3 | 2 |
| TV-928 | 2-1 | P | 4 | 6 |
| TV-944, Beverly; TV-945, Plaza; TV-946, Champion | 3-1 | P | 3 | 2 |
| TV-947, Baronet; TV-949, TV-950 | 3-11 | P | 3 | 2 |
| XL-210, XL-211, XL-612, XL-613 | 5-8 | P | 3 | 4 |
| **PACKARD-BELL CO.** | | | | |
| 1091, Ch. 3091; 1080, Radio Ch. | 4-1 | P | 3 | 5 |
| 2001-TV, 2002-TV | 5-1 | P | 3 | 4 |
| 2091-TV, 2092-TV | 5-3 | P | 3 | 4 |
| 2291TV, 2292TV, 2293TV, 2294TV, 2295TV, 2296TV | 4-10 | P | 3 | 4 |
| 2297-TV, DeLuxe, Standard; 2298-TV | 4-16 | P | 3 | 4 |
| 2601-TV, 2692-TV | 5-9 | P | 3 | 5 |
| 2981, Ch. | 4-5 | P | 3 | 5 |
| 2991-TV | 4-20 | P | 3 | 5 |
| 3191TV, 3192TV | 4-27 | P | 3 | 5 |
| 3193TV, 3194TV; 10520, R-F Tuner | 3-1 | P | 3 | 5 |
| 3381TV | 3-4 | P | 3 | 5 |
| 4580TV | 3-12 | P | 5 | 1 & 5 |
| 4691-TV | 4-18 | P | 5 | 1 & 5 |
| 10527, R-F Tuner | 3-23 | P | 1 | |
| **PATHE TELEVISION CORP.** | | | | |
| 12-2, Ch. 700 | 5-4 | P | 2 | 1 |
| 16-21, 16-22, 16-23, 16-24, 16-25, Ch. 700-1 | 5-9 | P | 3 | 2 |
| **PHILCO CORP.** | | | | |
| 48-700 | 2-1 | P | 3 | 2 |
| 48-1000, 48-1000-5, Code 125; | 1-1 | P | 3 | 4 |
| Code 122 | 2-20 | P | 3 | 4 |
| Code 121 | 2-37 | P | 3 | 4 |

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| **PHILCO CORP. (Cont'd)** | | | | |
| 48-1001, Code 121 | 1-17 | P | 3 | 4 |
| 48-1001, Code 122 | 1-17 | P | 3 | 4 |
| 48-2500, Code 122; 48-2500, 48-2500-5 | 1-23 | P | 3 | 4 |
| 49-1002 | 2-70 | P | 3 | 2 |
| 49-1040, Code 121 | 3-1 | P | 3 | 2 |
| 49-1040, Code 123 | 4-3 | P | 3 | 2 |
| 49-1075 | 2-70 | S, P | 4 | 12 |
| 49-1075, 49-1076, Code 122 | 4-25 | S, P | 4 | 12 |
| 49-1076, Code 123; 49-1077, Code 122 | 4-3 | S, P | 4 | 12 |
| 49-1150, Codes 121A, 121B, 122A, 122B | 3-4 | P | 3 | 2 |
| 49-1150, Codes 123A, 123B, 124A, 124B | 3-19 | P | 3 | 2 |
| 49-1175, Codes 121A, 121B, 122A, 122B | 3-4 | S, P | 4 | 12 |
| 49-1175, Codes 123A, 123B, 124A, 124B | 3-19 | S, P | 4 | 12 |
| 49-1240 | 2-70 | P | 3 | 2 |
| 49-1240, Code 123 | 4-25 | P | 3 | 2 |
| 49-1240, Code 124 | 4-3 | P | 3 | 2 |
| 49-1275 | 2-70 | S, P | 4 | 12 |
| 49-1278, Code 122 | 4-25 | S, P | 4 | 12 |
| 49-1278, Code 123, 49-1279, Code 122; 49-1280, Code 121 | 4-3 | S, P | 4 | 12 |
| 49-1450, Codes 121A, 121B | 3-4 | P | 2 | 1 |
| 49-1450, Codes 123A, 123B | 3-19 | P | 2 | 1 |
| 49-1450, Codes 123TA, 123TB | 3-23 | P | 2 | 1 |
| 49-1475, Codes 121A, 121B | 3-4 | S, P | 4 | 12 |
| 49-1475, Codes 123A, 123B | 3-19 | S, P | 4 | 12 |
| 49-1475, Codes 123TA, 123TB | 3-23 | S, P | 4 | 12 |
| 49-1480, Codes 121A, 121B | 3-4 | S, P | 4 | 12 |
| 49-1480, Codes 123A, 123B | 3-19 | S, P | 4 | 12 |
| 49-1480, Codes 123TA, 123TB | 3-23 | S, P | 4 | 12 |
| 50-T1104, Code 123 | 4-27 | P | 3 | 4 |
| 50-T1105, 50-T1106 | 5-1 | P | 3 | 4 |
| 50-T1400, 50-T1402, 50-T1404 | 4-27 | P | 3 | 4 |
| 50-T1600, 50-T1632, 50-T1633, Code 121 | 5-17 | P | 3 | 4 |
| **PHILHARMONIC RADIO CORP.** | | | | |
| TV-1049, TV-1249 | 2-1 | P | 4 | 6 |
| **PHILMORE MFG. CO., INC.** | | | | |
| P30 | 2-1 | P | 3 | 5 |
| **PILOT RADIO CORP.** | | | | |
| TV-37 | 2-1 | S-P | 2 | 27 |
| TV-37U | 2-1 | S-P | 2 | 27 |
| TV-40, TV-42 | 2-8 | P | 5 | 5 |
| TV-44 Series, TV-46, TV-47 | 3-1 | P | 3 | 5 |
| TV-120 Series, TV-121 | 3-10 | P | 3 | 2 |
| TV-125 | 5-1 | P | 3 | 2 |
| TV-161 | 5-1 | P | 4 | 6 |
| TV-950, TV-952 | 2-8 | P | 5 | 5 |
| **PLYMOUTH** See INTERSTATE STORES BUYING CORP. | | | | |
| **RADIO CORP. OF AMERICA (RCA)** | | | | |
| S1000, Ch. KCS31-1; RC617B, Radio Ch. | 5-48 | P | 3 | 2 |
| T100, Ch. KCS38 | 5-65 | P | 3 | 2 |
| T120, Ch. KCS34C | 5-80 | P | 3 | 2 |
| T121, Ch. KCS34C | 5-95 | P | 3 | 2 |
| TRK-5, Ch. KC-3A; RC-429, Radio Ch. | 1-1 | P | 4 | 5 |
| TRK-9, Ch. KC-4A, KC-4C; RC-427A, Radio Ch. | 1-14 | P | 5 | 5 |
| TRK-12, Ch. KC-4, KC-4B; RC-427, Radio Ch. | 1-14 | P | 5 | 5 |
| TRK-90, Ch. KC-4H; RC-427G, Radio Ch. | 1-14 | P | 5 | 5 |
| TRK-120, Ch. KC-4F, KC-4J; RC-427F, Radio Ch. | 1-14 | P | 5 | 5 |
| TT-5, Ch. KC-3 | 1-1 | P | 4 | 5 |
| 8PCS41, 8PCS41-B, 8PCS41-C, Ch. KCS-24B-1, KCS-24C-1 | 2-1 | P | 7 | 2 & 6 |
| 8T241, 8T243, 8T244, Ch. KCS-28 | 3-1 | P | 3 | 2 |
| 8T270, Ch. KCS-29; 8TC270, 8TC271, Ch. KCS-29A | 3-15 | P | 3 | 2 |
| 8TK29, Ch. KCS-32A, KCS-32C; RK-135, RK-135A, Radio Ch. | 3-29 | P | 4 | 3 |
| 8TK320, Ch. KCS33A-1; RK135A-1, Radio Ch. | 4-1 | P | 4 | 3 |
| 8TR29, Ch. KCS-32, KCS-32B; RK-135, RK-135A, Radio Ch. | 3-29 | P | 4 | 3 |
| 8TS30, Ch. KCS-20J-1, KCS-20K-2 | 2-11 | P | 3 | 5 |
| 8TV41, Ch. KCS-25D-1, KCS-25E-2; RK-117A, Radio Ch. | 2-26 | P | 3 | 5 |
| 8TV321, 8TV323, Ch. KCS-30-1; RC-616B, RC-616C, RC-616J, RC-616K, Radio Ch. | 3-43 | P | 3 | 2 |
| 9PC41, Ch. KCS24C-1, KCS24D | 4-16 | P | 7 | 2 & 6 |
| 9T240, Ch. KCS28; 9T240K, Ch. KCS28A | 4-26 | P | 3 | 2 |
| 9T246, Ch. KCS28C, KCS38 | 4-41 | P | 3 | 2 |
| 9T256, Ch. KCS38C | 5-1 | P | 3 | 2 |

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| **RADIO CORP. OF AMERICA (Cont'd)** | | | | |
| 9T270, Ch. KCS-29, KCS-29C | 3-61 | P | 3 | 2 |
| 9TC240, Ch. KCS28B | 4-26 | P | 3 | 2 |
| 9TC245, Ch. KCS34B; 9TC247, 9TC249, Ch. KCS34, KCS34B | 4-58 | P | 3 | 2 |
| 9TC272, 9TC275, Ch. KCS-29, KCS-29C | 3-61 | P | 3 | 2 |
| 9TW309, Ch. KCS41-1; RK135C, Radio Ch. | 5-16 | P | 4 | 6 |
| 9TW333, Ch. KCS30-1; RC-616N, Radio Ch. | 4-73 | P | 3 | 2 |
| 9TW390, Ch. KCS31-1; RC617A, Radio Ch. | 5-32 | P | 3 | 2 |
| 621TS, Ch. KCS-21-1 | 1-44 | P | 4 | 6 |
| 630TS, Ch. KCS-20A, KCS-20C-2 | 1-76 | P | 3 | 5 |
| 641TV, Ch. KCS-25A-1, KCS-25C-2; RK-117A, Radio Ch. | 1-117 | P | 3 | 5 |
| 648PTK, Ch. KCS-24-1; RK-121A, Radio Ch. | 1-174 | P | 5 | 3 |
| 648PV, Ch. KCS-24A-1; RK-121A, Radio Ch. | 1-174 | P | 5 | 3 |
| 721TCS, Ch. KCS-26A-1, KCS-26A-2 | 1-232 | P | 3 | 2 |
| 721TS, Ch. KCS-26-1, KCS-26-2 | 1-232 | P | 3 | 2 |
| 730TV1, Ch. KCS-27-1; RC-610A, Radio Ch. | 1-255 | P | 4 | 6 |
| 730TV2, Ch. KCS-27-1; RC-610B, Radio Ch. | 1-255 | P | 4 | 6 |
| 741PCS, Ch. KCS-24B-1 | 2-47 | P | 7 | 2 & 6 |
| **RADIO CRAFTSMEN, INC.** | | | | |
| RC100 | 4-1 | P | 2 | 1 |
| **RADIO MERCHANDISE SALES, INC.** | | | | |
| SP-2, Antenna Booster | 3-1 | P | 1 | |
| SP-4, Preamplifier | 4-1 | P | 1 | |
| **RADIO & TELEVISION INC. (BRUNSWICK)** | | | | |
| C-8125, C-8165 | 4-1 | P | 3 | 4 |
| 55B, 55M, 55R, 55W, Ch. 66Z, Canton | 2-1 | S, P | 4 | 28 |
| 506-B, Ch. 66Z, Tibet; L-14, Radio | 2-1 | S, P | 4 | 28 |
| 512, 513 | 4-1 | P | 3 | 4 |
| 702L; 711, Club; Ch. 66Z | 2-1 | S, P | 4 | 28 |
| 812, 816 | 4-1 | P | 3 | 4 |
| 911, 922B, 922M | 3-1 | P | 3 | 5 |
| 5125, 6165 | 4-1 | P | 3 | 4 |
| **RAYTHEON** See BELMONT RADIO CORP. | | | | |
| **REEVES-SOUNDCRAFT CORP. (VIDEON)** | | | | |
| AR-100 | 3-1 | P | 10 | 4,5 & 6 |
| **REGAL ELECTRONICS CORP.** | | | | |
| CD31, CD36 | 3-1 | P | 3 | 5 |
| TV-1030 | 2-1 | P | 3 | 5 |
| TV-1031 | 2-1 | P | 3 | 5 |
| 16T31 | 3-1 | P | 3 | 5 |
| 16T36 | 3-2 | P | 3 | 5 |
| 1007, 1207, 1208 | 3-4 | P | 4 | 3 |
| 1230 | 3-6 | P | 3 | 5 |
| 1607 | 3-7 | P | 4 | 3 |
| **REMBRANDT** See REMINGTON RADIO CORP. | | | | |
| **REMINGTON RADIO CORP. (REMBRANDT)** | | | | |
| Night Watch, Remington | 4-1 | P | 2 | 1 |
| 80, 130 | 1-1 | P | 5 | 3 |
| 721, 1606, 1606-15 | 4-1 | P | 2 | 1 |
| 1950 | 2-1 | P | 2 | 1 |
| 1950, Revised | 4-1 | P | 2 | 1 |
| **REPUBLIC TELEVISION INC.** | | | | |
| TL-10 | 1-1 | P | 3 | 2 |
| **SARKES TARZIAN** | | | | |
| TT2 | 4-1 | P | 1 | |
| TT3 | 4-3 | P | 1 | |
| **SCOTT RADIO LABS., INC.** | | | | |
| 6-T-11 | 2-1 | P | 4 | 6 |
| 13-A | 1-1 | P | 4 | 5 |
| 300 | 3-1 | P | 4 | 6 |
| **SEARS, ROEBUCK & CO.** | | | | |
| 101, Ch. 549.100 | 5-1 | P | 3 | 2 |
| 112, Ch. 478.289 | 5-9 | P | 4 | 5 |
| 125, Ch. 478.257 | 4-1 | P | 4 | 6 |
| 8132, Ch. 101.854 | 3-12 | P | 3 | 2 |
| 8133, Ch. 101.846; 101.829-1, Radio Ch. | 2-1 | P | 3 | 2 |
| 9119, 9120, Ch. 101.865 | 3-23 | P | 3 | 2 |
| 9120A, Ch. 101.865-1; 9120B, Ch. 101.865-2 | 4-37 | P | 2 | 1 |
| 9121, Ch. 101.867 | 4-10 | P | 2 | 1 |
| 9122, Ch. 101.864 | 3-12 | P | 3 | 2 |

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| **SEARS, ROEBUCK & CO. (Cont'd)** | | | | |
| 9122A, Ch. 101.868 | 4-19 | P | 2 | 1 |
| 9123, Ch. 110.499, 110.499A, 110.499B, 110.499-10, 110.499010A, 110.499-10B, 110.499-20, 110.499-10A, 110.499-20B | 3-1 | P | 2 | 1 |
| 9124, Ch. 110.499-1, 110.499-1A, 110.499-1B, 110.499-11, 110.499-11A, 110.499-11B, 110.499-21, 110.499-21A, 110.499-21B | 3-1 | P | 2 | 1 |
| 9125, Ch. 478.252; 9125A, Ch. 478.253 | 4-1 | P | 4 | 6 |
| 9125B, Ch. 478.253-1 | 5-18 | P | 4 | 6 |
| 9126, Ch. 110.499-2, 110.499-2A, 110.499-2B, 110.499-12, 110.499-12A 110.499-12B, 110.499-22, 110.499-22A, 110.499-22B | 3-1 | P | 2 | 1 |
| 9128A, Ch. 101.868 | 4-19, | P | 2 | 1 |
| 9133, 9134, Ch. 101.866; 101.859, Radio Ch. | 4-26 | P | 2 | 1 |
| **SENTINEL RADIO CORP.** | | | | |
| 1U416 | 5-1 | P | 4 | 6 |
| 1U419, 1U420 | 5-9 | P | 4 | 6 |
| 400TV | 2-1 | P | 3 | 2 |
| 400TV, Revised | 3-1 | P | 3 | 2 |
| 401, 402, Series | 3-8 | P | 3 | 4 |
| 405TVM | 2-1 | P | 3 | 2 |
| 405TVM, Revised | 3-1 | P | 3 | 2 |
| 406 Series | 3-8 | P | 3 | 4 |
| 407, 409 | 4-1 | P | 4 | 3 |
| 412, 413, 414, 415 | 4-10 | P | 4 | 6 |
| 416 | 5-1 | P | 4 | 6 |
| 419, 420 | 5-9 | P | 4 | 6 |
| **SHEVERS, INC.** | | | | |
| Bryant, Classic, Regency, Trafalgar, Ch. 032-16, 032-19 | 5-1 | P | 3 | 5 |
| **SIGHTMASTER CORP.** | | | | |
| E, Series | 2-3 | P | 3 | 2 |
| K-50 | 5-1 | P | 2 | 1 |
| M, Series | 2-3 | P | 3 | 2 |
| 10-S1, 12-S1, 15-S1 | 1-1 | P | 3 | 2 |
| 10-S1, 12-S1, 15-S1, Late | 2-1 | P | 3 | 2 |
| **MARK SIMPSON MFG. CO., INC. (MASCO)** | | | | |
| MTB-13X, 1MB-13 | 2-1 | P | 1 | |

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| **SKYRIDER** | | | | |
| 520E | 4-1 | P | 3 | 2 |
| 521E | 4-8 | P | 3 | 2 |
| **SONIC INDUSTRIES, INC.** | | | | |
| IT4 | 4-1 | P | 1 | |
| **SONORA RADIO & TELEV. CORP.** | | | | |
| 302, 303, 320 | 5-1 | P | 3 | 2 |
| 700 | 2-1 | P | 4 | 6 |
| 700A | 2-5 | P | 4 | 6 |
| **SOVEREIGN TELEVISION CO.** | | | | |
| 4920 | 3-1 | P | 4 | 6 |
| **SPARTON RADIO-TELEVISION DIV. OF THE SPARKS-WITHINGTON CO.** | | | | |
| 4900TV, Ch. 24TV9C; 9L8, Radio Ch. | 3-1 | P | 3 | 4 |
| 4901TV, Ch. 24TV9C | 4-1 | P | 3 | 4 |
| 4916, 4917, 4918, Ch. 24TL10; 6S10, Radio Ch. | 4-5 | P | 3 | 4 |
| 4920, 4921, 4922, Ch. 24TM10 | 4-11 | P | 3 | 4 |
| 4935, Ch. 23TC10 | 5-1 | P | 3 | 2 |
| 4939TV, Ch. 24TV9; 9L8, Radio Ch. | 3-1 | P | 3 | 4 |
| 4940TV, 4941TV, Ch. 24TV9; 9L8, Radio Ch. | 3-1 | P | 3 | 4 |
| 4942, Ch. 23TC10 | 5-1 | P | 3 | 2 |
| 4944, 4945, Ch. 24TB10 | 4-12 | P | 3 | 4 |
| 4951, 4952, Ch. 24TA10 | 4-1 | P | 3 | 4 |
| 4954, 4960, Ch. 23TC10 | 5-1 | P | 3 | 2 |
| 4964, 4965, Ch. 23TB10 | 5-15 | P | 3 | 4 |
| 4970, 4971, 4972, Ch. 24TF10 | 5-23 | P | 3 | 4 |
| 5002, 5003, 5006, 5007, Ch. 23TD10 | 5-1 | P | 3 | 2 |
| **STANDARD COIL PRODUCTS CO., INC.** | | | | |
| TV-100 Series | 2-1 | P | 1 | |
| **STARRETT TELEVISION CORP.** | | | | |
| M412 Series, Nathan Hale | 4-1 | P | 3 | 4 |
| 3R2-37-9, Lowell, Jackson, Cleveland, King Arthur, John Hancock | 4-2 | P | 3 | 5 |
| 3R3-36-9, Adams | 4-3 | P | 3 | 5 |
| 3R3-37-9, Lowell, Jackson, Cleveland, King Arthur, John Hancock | 4-2 | P | 3 | 5 |
| 3V3-429, Lincoln, Gotham, Washington, Cosmopolitan | 4-4 | P | 3 | 5 |
| 6S1-199, Sam Houston, Nathan Hale | 5-1 | P | 4 | 6 |
| 501-22-9, Henry Hudson, Henry Parks | 4-6 | P | 3 | 2 |

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| **STEWART-WARNER ELECTRIC DIV. OF STEWART-WARNER CORP.** | | | | |
| AVC1, Code 9054B; AVC2, Code 9054-C AVC3, Code 9054-B; AVT1, Code 9054-A | 3-15 | S-P | 6 | 30 |
| T-711, Code 9031-A; T-711M, Code 9031-AM; T-712, Code 9031-B; TRC-721, Code 9037-A | 2-1 | P | 3 | 2 |
| 9100-A, 9100-B, 9100-C, 9100-D, 9100-E, 9100-F, 9100-G, 9100-H | 3-1 | S-P | 5 | 29 |
| 9103-B, 9103-C, 9103-E | 4-1 | P | 2 | 1 |
| 9104-A, 9104-B, 9104-C | 4-22 | P | 2 | 1 |
| 9106-A, 9106-B | 5-1 | P | 2 | 1 |
| 9108-A, 9108-B | 5-15 | P | 2 | 1 |
| **STOLLE ENGINEERING & MFG. CO.** | | | | |
| Magic Lantern | 3-1 | P | 3 | 4 |
| 4830-12 | 3-2 | P | 3 | 5 |
| **STROMBERG-CARLSON CO.** | | | | |
| TC-10, Manhattan | 4-1 | P | 2 | 1 |
| TC-19, TC-19 Rev., TC-19-M5M | 5-1 | P | 4 | 5 |
| TC-125 | 4-5 | P | 2 | 1 |
| TS-15, TS-16, TS-125, Series | 3-1 | P | 4 | 5 |
| TV-10L, Ch. 112020, Series 10 | 1-1 | P | 7 | 4 & 6 |
| TV-10L, Ch. 112020, Series 11 | 1-1 | P | 7 | 4 & 6 |
| TV-10LW, Ch. 112020, Series 10 | 1-1 | P | 7 | 4 & 6 |
| TV-10LW, Ch. 112020, Series 11 | 1-1 | P | 7 | 4 & 6 |
| TV-10PM, Ch. 112025, Series 11; 1220, Ch. 112022, Radio | 1-1 | P | 7 | 4 & 6 |
| TV-10PY, Ch. 112025, Series 11; 1220, Ch. 112022, Radio | 1-1 | P | 7 | 4 & 6 |
| TV-12H1M, TV-12H2A, TV-12H2M, Ch. 112040; TV-12LM, Ch. 112035; TV-12M5M, TV-12PGM, Ch. 112034; 1220T, Ch. 112031, Radio | 1-17 | P | 3 | 2 |
| 16-CA, 16-CM, 16-RPM, 16-TA, 16-TM | 5-8 | P | 3 | 2 |
| **SYLVANIA ELECTRIC PRODUCTS INC.** | | | | |
| 1-075, Ch. 1-139 | 4-1 | P | 2 | 1 |
| 1-076, Ch. 1-108 | 5-1 | P | 2 | 1 |
| 1-090, Ch. 1-168 | 4-16 | P | 2 | 1 |
| 1-113, 1-114, 1-124, 1-125, Ch. 1-139 | 4-1 | P | 2 | 1 |
| 1-128, Ch. 1-108 | 5-1 | P | 2 | 1 |
| 1-177, Ch. 1-186 | 4-14 | P | 2 | 1 |
| 1-210, Ch. 1-139 | 4-1 | P | 2 | 1 |
| **TECH-MASTER PRODUCTS CO. (VIDEOLA)** | | | | |
| AGC Kit | 4-1 | P | 1 | |
| BC 1223, Blue Ribbon | 4-2 | P | 3 | 2 |
| TVB, Booster Kit | 4-6 | P | 1 | |
| 16CK, Conversion Kit | 4-8 | P | 1 | |
| 630TK, Same as RCA 630TS | 1-76 | P | 1 | |
| 930, 1230 | 3-1 | P | 3 | 5 |
| 1530, 1630, 1631, 2031 | 3-2 | P | 3 | 5 |
| **TELECOIN CORP. (TELE-VIDEO)** | | | | |
| AR-100, Same as Reeves-Soundcraft AR-100 | 3-1 | P | 10 | 4,5&6 |
| **TELECRAFT CORP.** | | | | |
| 15-Inch Set, See RCA 8TS30 | 2-11 | P | 3 | 5 |
| **TELE-KING CORP.** | | | | |
| 210, 310 | 2-1 | P | 5 | 3 |
| 410 | 3-1 | P | 3 | 4 |
| 416 | 5-1 | P | 3 | 4 |
| 510 | 4-1 | P | 3 | 4 |
| 512 | 3-1 | P | 3 | 4 |
| 612 | 3-1 | P | 3 | 4 |
| 612, Revised | 4-1 | P | 3 | 4 |
| 616 | 5-1 | P | 3 | 4 |
| 710 | 3-1 | P | 3 | 4 |
| 712 | 4-1 | P | 3 | 4 |
| 716 | 5-1 | P | 3 | 4 |
| 816 | 5-1 | P | 3 | 4 |
| **TELEKIT** See ELECTRO-TECHNICAL INDUSTRIES | | | | |
| **TELE-TONE RADIO CORP.** | | | | |
| 7-Inch AC-DC | 2-1 | S-P | 3 | 31 |
| TV-149 | 2-2 | S-P | 3 | 32 |
| TV-208TR | 3-1 | S-P | 3 | 17 |
| TV-249 | 2-7 | P | 4 | 6 |
| TV-254TR, Ch. TK | 4-1 | P | 2 | 1 |
| TV-255, TV-256, Ch. TS | 4-6 | P | 3 | 2 |
| TV-284, Ch. TJ | 4-12 | P | 4 | 5 |
| TV-284 up to Serial #C12-127, Ch. TH, TJ | 5-2 | P | 4 | 5 |
| TV-286, Ch. TJ | 4-12 | P | 4 | 5 |

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| **TELE-TONE RADIO CORP. (Cont'd)** | | | | |
| TV-286 up to Serial #C16-263, Ch. TH, TJ | 5-2 | P | 4 | 5 |
| TV-287, Ch. TJ | 4-12 | P | 4 | 5 |
| TV-287 after Serial #12-100, Ch. TH, TJ | 5-2 | P | 4 | 5 |
| TV-288, Ch. TJ | 4-12 | P | 4 | 5 |
| 220, Ch. TR, Rev. | 5-1 | S-P | 3 | 17 |
| **TELE-VIDEO** See TELECOIN CORP. | | | | |
| **TELEVISION ASSEMBLY CO. SUBSIDIARY OF SNAIDER TELEVISION CORP.** | | | | |
| Champion, Standard | 3-1 | P | 3 | 5 |
| F1-101 | 1-1 | P | 3 | 5 |
| P-520 | 2-1 | P | 6 | 3 |
| **TELEVISION DEVELOPMENT LABS., INC.** | | | | |
| 820A, Televue | 1-1 | P | 3 | 2 |
| **TELEVISION EQUIPMENT CORP.** | | | | |
| S-501, Antenna Multicoupler | 3-1 | P | 1 | |
| **TELEVISTA CORP. OF AMERICA** | | | | |
| Arista, Electra, Empress | 4-1 | P | 4 | 6 |
| Monte Carlo | 2-1 | P | 3 | 5 |
| Trafton | 4-1 | P | 4 | 6 |
| 100, Monte Carlo | 2-1 | P | 3 | 5 |
| 104, Arista, Electra, Empress, Trafton | 4-1 | P | 4 | 6 |
| **TELINDUSTRIES, INC. (KAYE-HALBERT)** | | | | |
| 821, 921, 1621 | 4-1 | P | 3 | 2 |
| **TEL VISION** | | | | |
| TR7-1, Ch. TR10C-1 | 1-1 | P | 2 | 1 |
| TR10-1, Ch. TR10C-1 | 1-1 | P | 2 | 1 |
| **TEMPLE** See TEMPLETONE RADIO MFG. CORP. | | | | |
| **TEMPLETONE RADIO MFG. CORP. (TEMPLE)** | | | | |
| TV-1776 | 2-1 | P | 2 | 1 |
| **TRAD TELEVISION CORP.** | | | | |
| 13, 14 | 3-1 | P | 5 | 3 |
| TT-63-SH | 5-1 | P | 3 | 5 |
| **TRADIO, INC. (TRADIOVISION)** | | | | |
| 9 | 1-1 | P | 5 | 1&4 |

| Model | Rider Man. Page | Type Cir. | No. of Chains | Sch. |
|---|---|---|---|---|
| **TRADIOVISION** See TRADIO, INC. Also See TRAD TELEVISION CORP. | | | | |
| **TRANSVISION, INC.** | | | | |
| Booster | 2-6 | P | 1 | |
| A-1 | 2-1 | P | 2 | 1 |
| A-2 | 2-4 | P | 2 | 1 |
| A-3 | 2-1 | P | 2 | 1 |
| 7-Inch Kit, Early | 1-1 | P | 3 | 2 |
| 7-Inch Kit, Late | 1-1 | P | 3 | 2 |
| 12-Inch Kit | 1-31 | P | 3 | 2 |
| **TRANS-VUE CORP.** | | | | |
| 90X, 90XFM, 90XFMB | 4-1 | P | 4 | 6 |
| 145, 145B | 3-1 | P | 4 | 6 |
| 160-L, Entertainer | 3-3 | S-P | 6 | 33 |
| 400 | 5-1 | P | 2 | 1 |
| 601, 610, Ch. 16AX23, 16AX25, 16AX26 | 5-11 | P | 2 | 1 |
| **TRAV-LER RADIO CORP.** | | | | |
| 10T | 3-1 | P | 3 | 4 |
| 12L50 | 5-1 | P | 4 | 6 |
| 12T | 3-1 | P | 3 | 4 |
| 16G50, 16R50 | 5-1 | P | 4 | 6 |
| 16-T | 4-1 | P | 3 | 4 |
| 16T, Rev. | 5-11 | P | 3 | 4 |
| 16T50 | 5-1 | P | 4 | 6 |
| **UNITED MOTORS SERVICE DIV. OF GENERAL MOTORS CORP.** | | | | |
| TV-71 | 2-1 | S-P | 3 | 25 |
| TV-71A | 2-6 | S-P | 3 | 25 |
| TV-101 | 3-1 | P | 3 | 2 |
| TV-102 | 4-1 | P | 3 | 2 |
| TV-121, TV-122 | 5-1 | P | 3 | 2 |
| TV-160 | 4-9 | P | 3 | 2 |
| TV-201 | 3-8 | P | 3 | 2 |
| **U.S. TELEVISION MFG. CORP.** | | | | |
| R-F Tuner, Type A | 1-1 | P | 1 | |
| 10-Inch Direct View | 1-37 | P | 3 | 2 |
| 10-Inch Direct View; 15-Inch Direct View | 1-39 | P | 3 | 2 |
| C1630, C19031 | 4-1 | P | 3 | 5 |
| CFM12823-1, CFM15925 | 3-1 | P | 3 | 2 |
| CFM16031, CFM19032 | 4-1 | P | 3 | 5 |

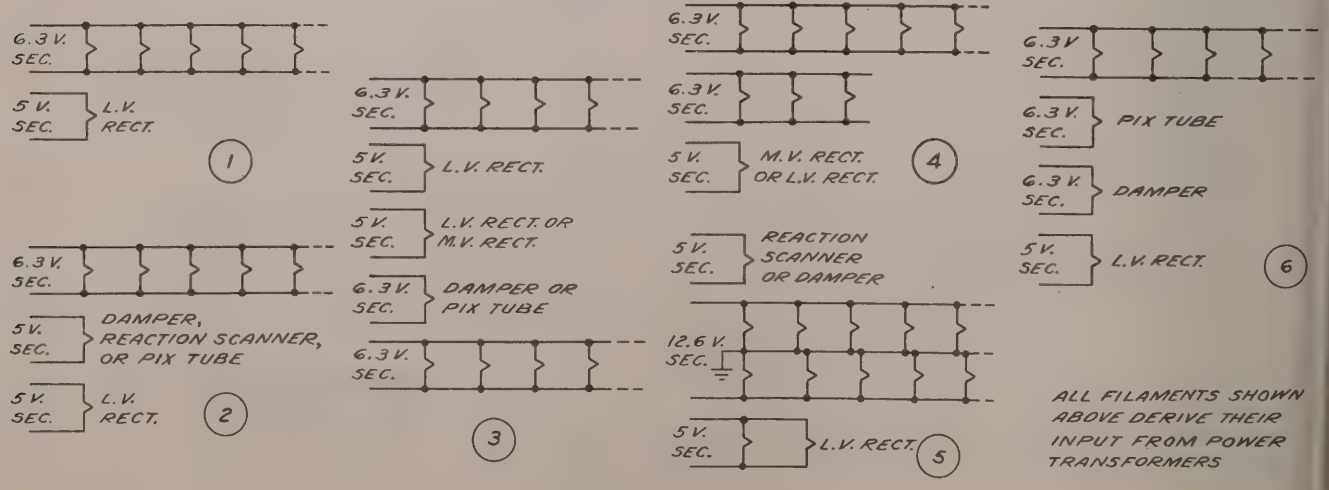
| Model | Rider Man. Page | Type Cir. | No. of Chains | Sch. |
|---|---|---|---|---|
| **U.S. TELEVISION MFG. CORP. (Cont'd)** | | | | |
| KRV12823-1, KRV15831-3 | 3-1 | P | 3 | 2 |
| T502, T507, T508, T521, T525, T530, T621 | 1-13 | P | 4 | 3 |
| T10823 | 2-1 | P | 3 | 2 |
| T16030, T19031, TFM16031, TFM19032 | 4-1 | P | 3 | 5 |
| **VIDAIRE TELEVISION CO.** | | | | |
| SC-1 Tuner | 4-2 | P | 1 | |
| 100 | 3-1 | P | 3 | 5 |
| 100A | 3-1 | P | 3 | 5 |
| **VIDCRAFT TELEVISION CORP.** | | | | |
| A-101, Add-A-Vision | 2-1 | P | 4 | 6 |
| 017, 017B, 017C, 017D | 5-1 | P | 3 | 4 |
| 024 Series | 5-2 | P | 3 | 2 |
| 5700R | 2-3 | P | 5 | 1&5 |
| **VIDEO CORP. OF AMERICA** | | | | |
| VS-120 | 2-1 | P | 4 | 6 |
| VS-160 | 4-1 | P | 4 | 6 |
| 1510 | 2-2 | P | 3 | 5 |
| **VIDEODYNE, INC.** | | | | |
| 10FM, 10TV, 12FM, 12TV | 2-1 | P | 4 | 6 |
| **VIDEOLA** See TECH-MASTER PRODUCTS CO. | | | | |
| **VIDEON** See REEVES-SOUNDCRAFT CORP. | | | | |
| **VIEWTONE TELEVISION & RADIO CORP.** | | | | |
| VP100, VP100A, VP101A, Adventurer, Futura | 1-1 | P | 3 | 2 |
| **VISION RESEARCH LABS., INC.** | | | | |
| F-M Teletuner | 2-1 | P | 1 | |
| TVA | 2-1 | P | 1 | |
| TVX | 2-2 | P | 1 | |
| TVZ | 2-2 | P | 1 | |
| **WARWICK MFG. CORP.** | | | | |
| 167 | 5-1 | P | 3 | 4 |
| **WESTERN AUTO SUPPLY CO.** | | | | |
| D1090 | 5-1 | P | 3 | 2 |
| D1092 | 5-7 | P | 3 | 4 |
| D1990 | 3-1 | S-P | 6 | 10 |
| D1991A, D1991B | 3-15 | P | 4 | 6 |
| D1992 | 3-1 | S-P | 6 | 10 |
| D1993A, D1993B | 3-15 | P | 4 | 6 |
| D1994 | 4-1 | P | 4 | 6 |
| D1996 | 4-11 | P | 3 | 2 |
| D1997A, D1998A | 5-12 | P | 4 | 6 |
| D1998B | 5-12 | P | 3 | 2 |
| D2044 | 5-28 | P | 2 | 1 |
| D2047 | 5-22 | P | 2 | 1 |
| D2050A | 5-12 | P | 4 | 6 |
| D2982 | 4-18 | P | 3 | 4 |
| D2983 | 4-11 | P | 3 | 2 |
| D2985A, D2985B | 3-24 | S-P | 3 | 9 |
| D2987 | 3-1 | S-P | 6 | 10 |
| 10AX21, Ch. | 5-32 | P | 2 | 1 |
| 10AXF44, Ch. 10AX21 | 5-32 | P | 2 | 1 |
| **WESTINGHOUSE ELECTRIC CORP.** | | | | |
| H-181 | 1-30 | P | 3 | 2 |
| H-196, Ch. V-2130 | 3-1 | P | 4 | 5 |
| H-216, Ch. V-2146-05DX; H-216A, Ch. V-2146-45DX | 5-1 | P | 4 | 5 |
| H-217, H-217A, Ch. V-2146-1 | 5-11 | P | 6 | 5 |
| H-217, H-217A, Ch. V-2146-11DX; H-217B, Ch. V-2146-35DX | 5-11 | P | 4 | 5 |
| H-223, Ch. V-2150-01 | 3-19 | P | 3 | 5 |
| H-226, Ch. V-2146-21DX, V-2146-25DX | 5-26 | P | 4 | 5 |
| H-231, Ch. V-2150-51; V-2137-3, V-2137-3S, Radio Ch. | 5-35 | P | 3 | 5 |
| H-242, Ch. V-2150-31 | 4-1 | P | 3 | 5 |
| H-251, Ch. V-2150-81, V-2150-82, V-2150-84 | 4-9 | P | 3 | 5 |
| H-600T16, Ch. V-2150-61 | 4-17 | P | 3 | 5 |
| H-601K12, H-602K12, Ch. V-2150-41 | 4-25 | P | 3 | 5 |
| H-603C12, Ch. V-2152-01 | 5-46 | P | 5 | 5 |
| H-604T10, H-604T10A, Ch. V-2150-91A, V-2150-94, V-2150-94A | 4-33 | P | 3 | 5 |
| H-605T12, Ch. V-2150-101 | 5-55 | P | 3 | 5 |
| H-608C12, Ch. V-2152-01 | 5-46 | P | 5 | 5 |
| WRT-700, WRT-701 | 1-1 | P | 4 | 5 |
| WRT-702, WRT-703 | 1-7 | P | 5 | 5 |
| **WILCOX-GAY CORP.** | | | | |
| OD Series, Serial Nos. below 26,000 | 5-1 | P | 4 | 6 |
| OF Series | 5-11 | P | 4 | 6 |

# RECEIVING TUBE SUBSTITUTION GUIDE

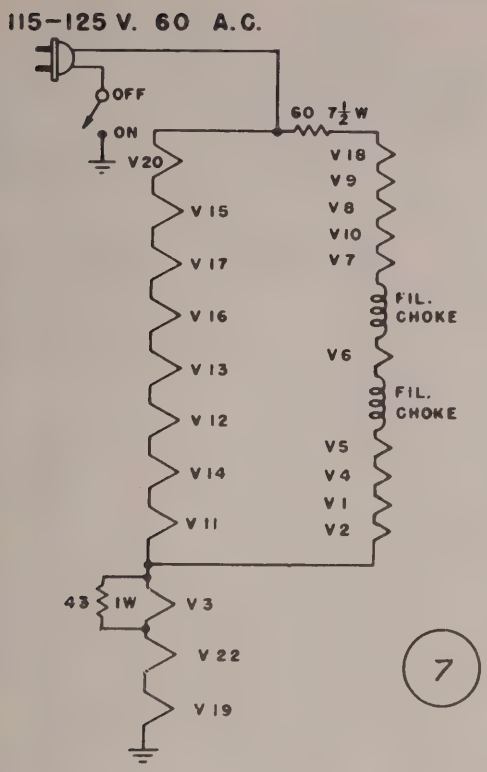
| Model | Rider Man. Page | Type Cir. | No. of Chains | Sch. |
|---|---|---|---|---|
| **WILCOX-GAY CORP. (Cont'd)** | | | | |
| OL Series, Serial Nos. Below 26,000 | 5-22 | P | 3 | 2 |
| 9V Series | 4-1 | P | 2 | 1 |
| 9W Series | 4-12 | S,P | 2 | 34 |
| **ZENITH RADIO CORP.** | | | | |
| G2322, Ch. 23G22, Claridge | 4-17 | S-P | 5 | 35 |
| G2322Z, G2327Z, Ch. 23G24, Garfield | 4-38 | P | 3 | 5 |
| G2340, Ch. 23G22, Endear; G2340R, Ch. 23G22, Saratoga | 4-17 | S-P | 5 | 35 |
| G2340RZ, Ch. 23G24, Adams; G2340, Ch. 23G24, Ensign | 4-38 | P | 3 | 5 |
| G2346R, Ch. 23G22, Graemere | 4-17 | S-P | 5 | 35 |
| G2350RZ, Ch. 23G24, Adams; G2350Z, Ch. 23G24, Ensign | 4-38 | P | 3 | 5 |
| G2353E, Ch. 23G22, Biltmore | 4-17 | S-P | 5 | 35 |
| G2353EZ, G2356EZ, Ch. 23G24, Tyler | 4-38 | P | 3 | 5 |
| G2420E, Ch. 24G20, Wilshire; G2420-EOX, Ch. 24G20-OX, Wilshire, G2420R, Ch. 24G20, Newport; G2420-ROX, Ch. 24G20-OX, Newport | 4-1 | P | 4 | 6 |
| G2437RZ, Jackson; G2438RZ, Lincoln; G2438Z, Entice; G2439RZ, Monroe; Ch. 24G26 | 4-38 | P | 3 | 5 |
| G2441, Ch. 24G24, Endow; G2441R, Ch. 24G22, 24G24, Lexington | 4-17 | S-P | 5 | 35 |
| G2441RZ, Lincoln; G2441Z, Entice; Ch. 24G26 | 4-38 | P | 3 | 5 |
| G2442E, Waldorf; G2442R, Mayfair; Ch. 24G22, 24G24 | 4-17 | S-P | 5 | 35 |
| G2442RZ, Jackson; G2448RZ, Monroe; Ch. 24G26 | 4-38 | P | 3 | 5 |
| G2454R, Ch. 24G21; G2454-RCX, Ch. 24G21-OX | 4-1 | P | 4 | 6 |

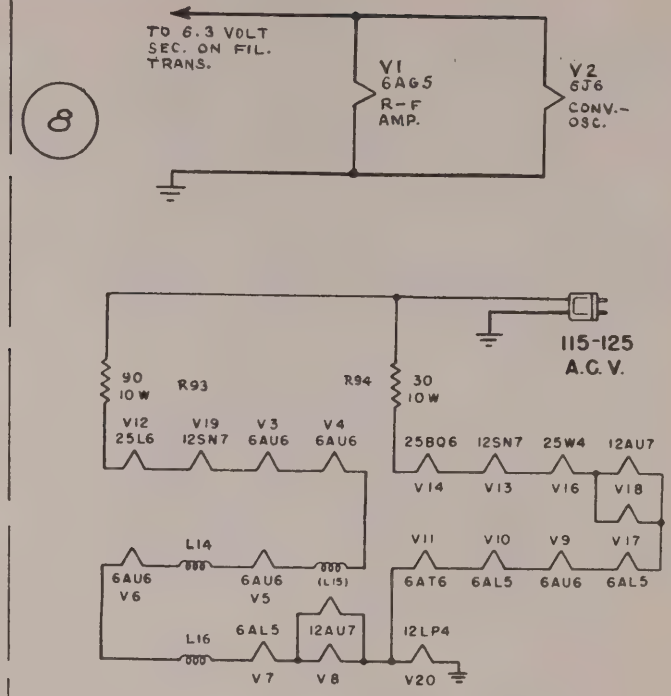
| Model | Rider Man. Page | Type Cir. | No. of Chains | Sch. |
|---|---|---|---|---|
| **ZENITH RADIO CORP. (Cont'd)** | | | | |
| G2951, G2951R, Stratosphere; G2952R, St. Regis; Ch. 29G20 | 3-1 | P | 5 | 5 |
| G2957, Ch. 23G23, Endue; G2957R, Ch. 23G23, Regent; G3059R, Ch. 24G23, 24G25, Sheraton; G3062, Ch. 24G23, 24G25, Classic; 6G20, Radio Ch. | 4-17 | S-P | 5 | 35 |
| G3157RZ, Madison; G3157Z, Entwine; G3158RZ, Van Buren; G3173RZ, Madison; G3173Z, Entwine; G3174RZ, Van Buren; Ch. 23G24 | 4-38 | P | 3 | 5 |
| G3259RZ, Washington; G3262Z, Jefferson; G3275RZ, Washington; G3276Z, Jefferson; Ch. 24G26 | 4-38 | P | 3 | 5 |
| 27T965R, Ch. 27F20, 27F20Z, Broadmoor | 3-1 | P | 5 | 5 |
| 28T295, Ch. 28F22 | 2-1 | P | 5 | 5 |
| 28T925E, 28T925EU, Ch. 28F22, Revised, Biltmore; 28T295R, 28T92RU, Ch. 28F22 Revised, Mayflower; 28T926E, Ch. 28F25, Saratoga; 28T926R, Ch. 28F25, Claridge | 3-1 | P | 5 | 5 |
| 28T960, Ch. 28F20 | 2-1 | P | 5 | 5 |
| 28T960E, Ch. 28F20 Revised, 28F20Z, Waldorf; 28T960K, Ch. 28F20 Revised, Derby | 3-1 | P | 5 | 5 |
| 28T961, Ch. 28F21 | 2-1 | P | 5 | 5 |
| 28T961E, Ch. 28F21 Revised, Wilshire | 3-1 | P | 5 | 5 |
| 28T962, Ch. 28F20 | 2-1 | P | 5 | 5 |
| 28T962R, Ch. 28F20, Revised, Warwick | 3-1 | P | 5 | 5 |
| 28T963, Ch. 28F21 | 2-1 | P | 5 | 5 |
| 28T963R, Ch. 28F21 Revised, Newport; 28T964R, Ch. 28F23, Stratosphere | 3-1 | P | 5 | 5 |
| 29G20, Ch. | 3-1 | P | 5 | 5 |
| 37T996RLP, Ch. 28F23, Sovereign; 37T998RLP, Ch. 9E21Z, 28F20 Revised, Gotham; 42T999RLP, Ch. 28F23 Marlborough | 3-1 | P | 5 | 5 |

## FILAMENT SCHEMATICS



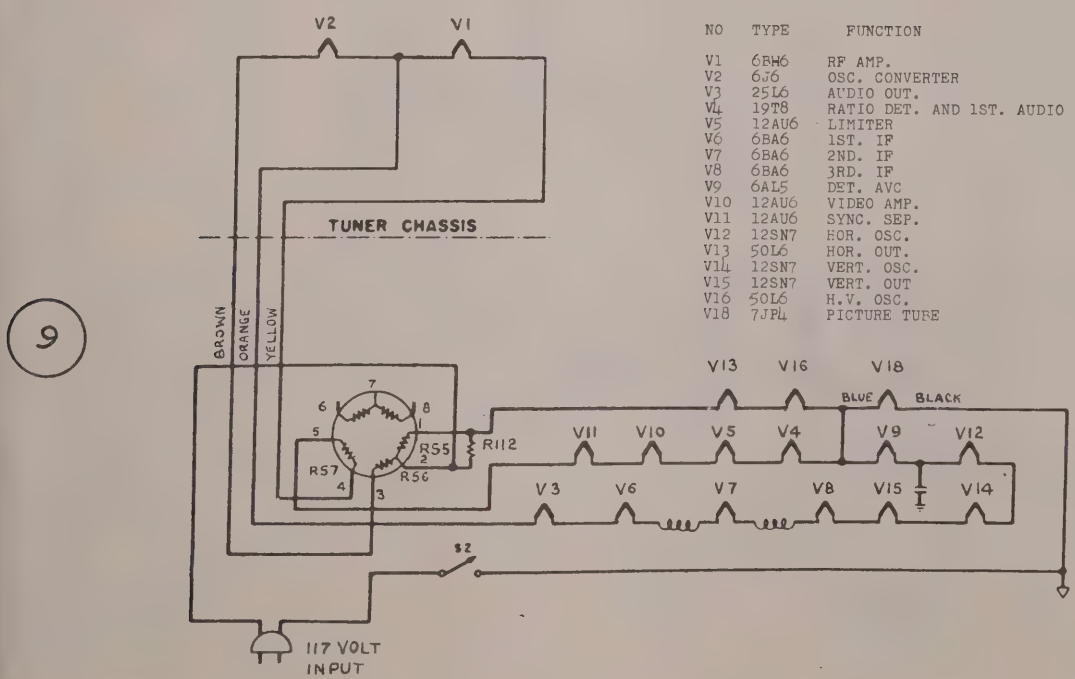
# RECEIVING TUBE SUBSTITUTION GUIDE



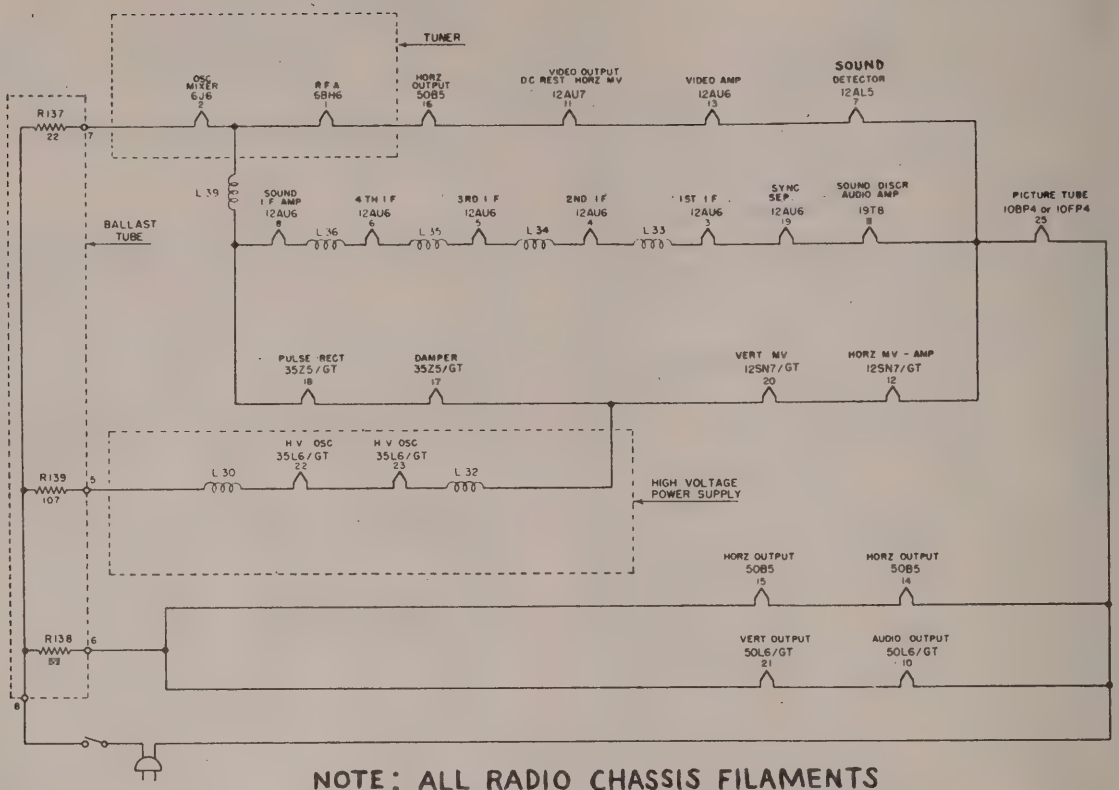




| NO | TYPE | FUNCTION | NO | TYPE | FUNCTION |
|---|---|---|---|---|---|
| 1 | 6AU6 | RF AMP. | V12 | 6AT6 | AUDIO AMP. |
| 2 | 6AG5 | MIXER | V13 | 25L6 | AUDIO OUTPUT |
| 3 | 6J6 | RF OSC. | V14 | 12SN7 | HORIZ. OSC. |
| 4 | 6AU6 | 1ST. IF AMP. | V15 | 12SN7 | HORIZ. OUTPUT |
| 5 | 6AU6 | 2ND. IF AMP. | V16 | 12SN7 | VERT. OSC. |
| 6 | 6AU6 | 3RD. IF AMP. | V17 | 12SN7 | VERT. OUTPUT |
| 7 | 6AL5 | VIDEO 2ND. DETECTOR | V18 | 25Z6 | L.V.RECTIFIER |
| 8 | 6AU6 | VIDEO AMP. | V19 | 6X5 | L.V.RECTIFIER |
| 9 | 6AU6 | VIDEO OUTPUT | V20 | 12SN7 | H.V. OSC. |
| 10 | 6AU6 | RATIO DETECTOR DRIVER | V22 | 7JP4 | PICTURE TUBE |
| 11 | 6AL5 | RATIO DETECTOR | | | |

| NO | TYPE | FUNCTION | NO | TYPE | FUNCTION |
|---|---|---|---|---|---|
| V1 | 6AG5 | RF AMP. | V11 | 6AT6 | AUDIO AMP. |
| V2 | 6J6 | CONVERTER OSC. | V12 | 25L6 | AUDIO OUT. |
| V3 | 6AU6 | 1ST. IF AMP. | V13 | 12SN7 | HOR. OSC. AND DISCH. |
| V4 | 6AU6 | 2ND. IF AMP. | V14 | 25BQ6 | HOR. OUT. |
| V5 | 6AU6 | 3RD. IF AMP. | V16 | 25W4 | HOR. DAMP. |
| V6 | 6AU6 | 4TH. IF AMP. | V17 | 6AL5 | HOR. SYNC. DISCR. |
| V7 | 6AL5 | PIX 2ND DET. | V18 | 12AU7 | SYNC. SEP. AND AMP. |
| V8 | 12AU7 | 1ST. AND 2ND. VIDEO AMP. | V19 | 12SN7 | VERT. OSC. AND OUT. |
| V9 | 6AU6 | 1ST. SOUND IF | V20 | 12LP4 | PICTURE TUBE |
| V10 | 6AL5 | AUDIO DISCR. | | | |




| NO | TYPE | FUNCTION |
|---|---|---|
| V1 | 6BH6 | RF AMP. |
| V2 | 6J6 | OSC. CONVERTER |
| V3 | 25L6 | AUDIO OUT. |
| V4 | 19T8 | RATIO DET. AND 1ST. AUDIO |
| V5 | 12AU6 | LIMITER |
| V6 | 6BA6 | 1ST. IF |
| V7 | 6BA6 | 2ND. IF |
| V8 | 6BA6 | 3RD. IF |
| V9 | 6AL5 | DET. AVC |
| V10 | 12AU6 | VIDEO AMP. |
| V11 | 12AU6 | SYNC. SEP. |
| V12 | 12SN7 | HOR. OSC. |
| V13 | 50L6 | HOR. OUT. |
| V14 | 12SN7 | VERT. OSC. |
| V15 | 12SN7 | VERT. OUT |
| V16 | 50L6 | H.V. OSC. |
| V18 | 7JP4 | PICTURE TUBE |




NOTE: ALL RADIO CHASSIS FILAMENTS ARE IN SERIES ACROSS THE LINE.

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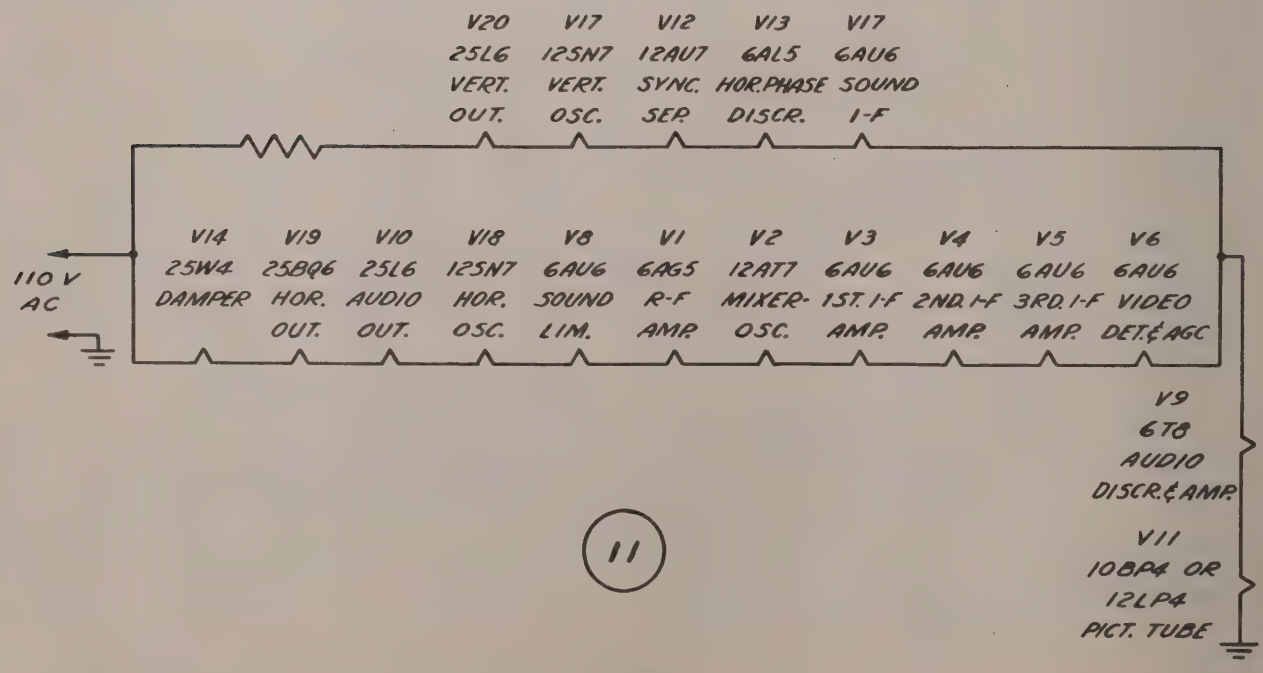
V20 25L6 VERT. OUT.
V17 12SN7 VERT. OSC.
V12 12AU7 SYNC. SEP.
V13 6AL5 HOR. PHASE DISCR.
V17 6AU6 SOUND I-F
110 V AC
V14 25W4 DAMPER
V19 25BQ6 HOR. OUT.
V10 25L6 AUDIO OUT.
V18 12SN7 HOR. OSC.
V8 6AU6 SOUND LIM.
V1 6AG5 R-F AMP.
V2 12AT7 MIXER-OSC.
V3 6AU6 1ST. I-F AMP.
V4 6AU6 2ND. I-F AMP.
V5 6AU6 3RD. I-F AMP.
V6 6AU6 VIDEO DET. & AGC
V9 6T8 AUDIO DISCR. & AMP.
V11 10BP4 OR 12LP4 PICT. TUBE

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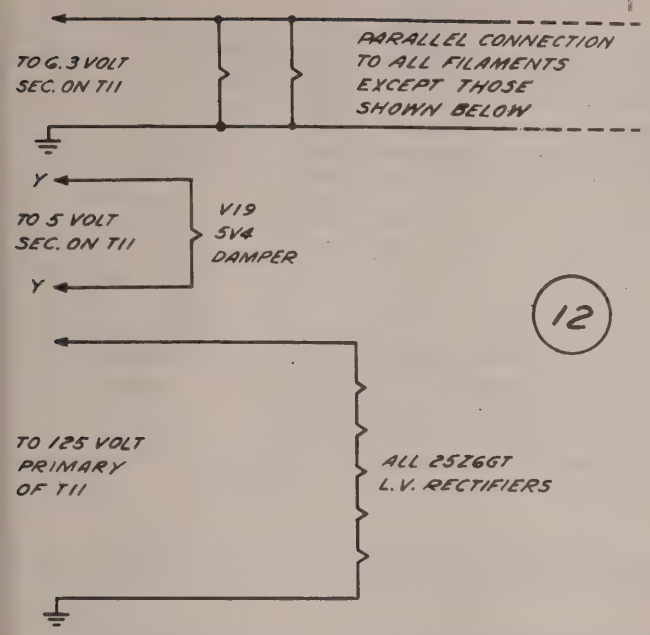
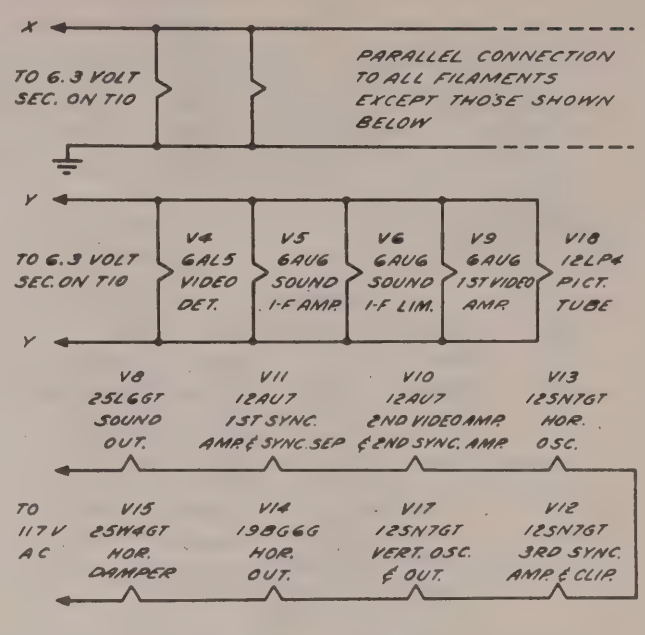
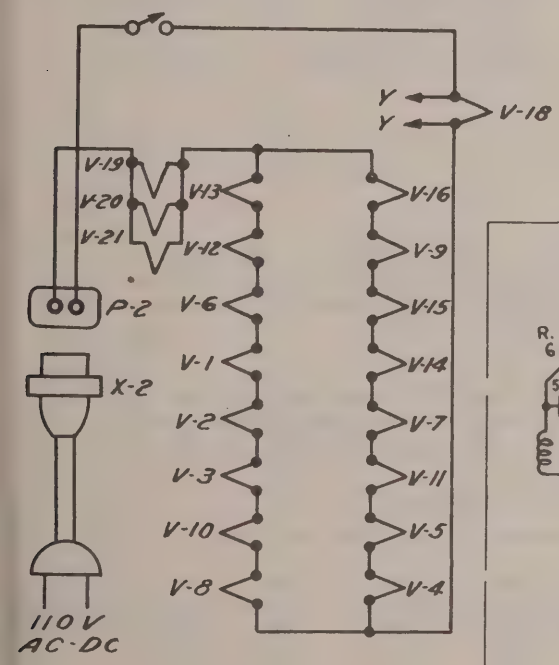

TO 6.3 VOLT SEC. ON T11
PARALLEL CONNECTION TO ALL FILAMENTS EXCEPT THOSE SHOWN BELOW
Y
TO 5 VOLT SEC. ON T11
V19 5V4 DAMPER
Y
TO 125 VOLT PRIMARY OF T11
ALL 25Z6GT L.V. RECTIFIERS
12


X
TO 6.3 VOLT SEC. ON T10
PARALLEL CONNECTION TO ALL FILAMENTS EXCEPT THOSE SHOWN BELOW
Y
TO 6.3 VOLT SEC. ON T10
V4 6AL5 VIDEO DET.
V5 6AU6 SOUND I-F AMP.
V6 6AU6 SOUND I-F LIM.
V9 6AU6 1ST VIDEO AMP.
V18 12LP4 PICT. TUBE
Y
V8 25L6GT SOUND OUT.
V11 12AU7 1ST SYNC. AMP & SYNC. SEP
V10 12AU7 2ND VIDEO AMP. & 2ND SYNC. AMP.
V13 12SN7GT HOR. OSC.
TO 117 V A C
V15 25W4GT HOR. DAMPER
V14 19BG6G HOR. OUT.
V17 12SN7GT VERT. OSC. & OUT.
V12 12SN7GT 3RD SYNC. AMP. & CLIP.
TO 5 VOLT SEC. ON T10
V19 5U4G L. V. RECT.
14




| NO | TYPE | FUNCTION |
|---|---|---|
| V1 | 6AU6 | 1st VIDEO IF |
| V2 | 6AU6 | 2nd VIDEO IF |
| V3 | 6AU6 | 3rd VIDEO IF |
| V4 | 6AL5 | DET., AGC |
| V5 | 12AU7 | SYNC SEP, 1st VIDEO |
| V6 | 25L6 | 2nd VIDEO AMP. |
| V7 | 6SH7 | LIM., SOUND IF |
| V8 | 6S8 | DET., AUDIO AMP. |
| V9 | 25L6 | AUDIO OUT. |
| V10 | 6AL5 | AFC PHASE DET. |
| V11 | 12AU7 | PHASE INV., DC AMP. |
| V12 | 12SN7 | HOR. OSC. |
| V13 | 25L6 | HOR. AMP. |
| V14 | 12SN7 | VERT. OSC. |
| V15 | 6SL7 | VERT. AMP. |
| V16 | 25L6 | H.V. OSC. |
| V18 | 7JP4 | PICT. TUBE |
| V19 | 6J6 | OSC. |
| V20 | 6J6 | CONV. |
| V21 | 6J6 | RF AMP. |

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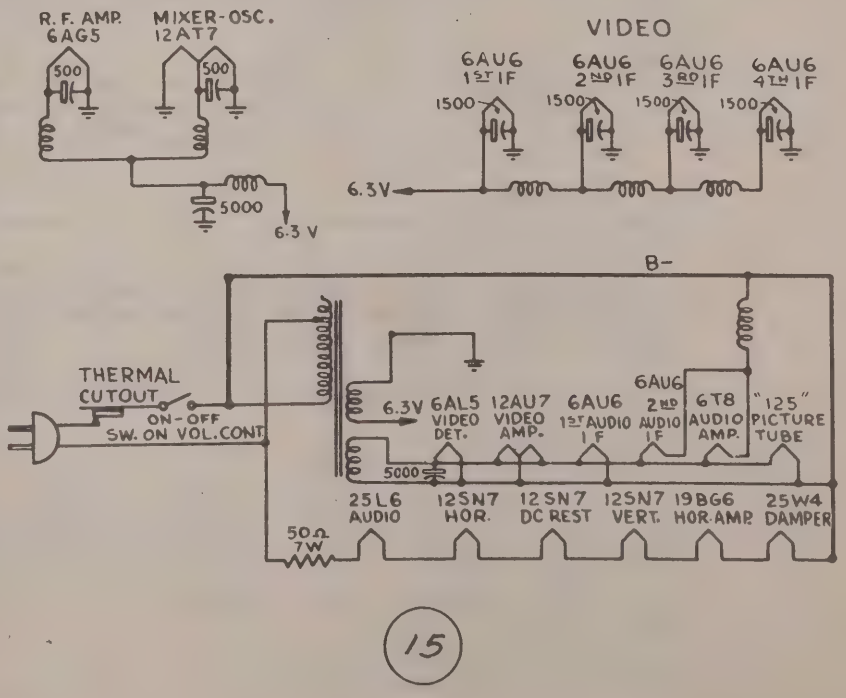
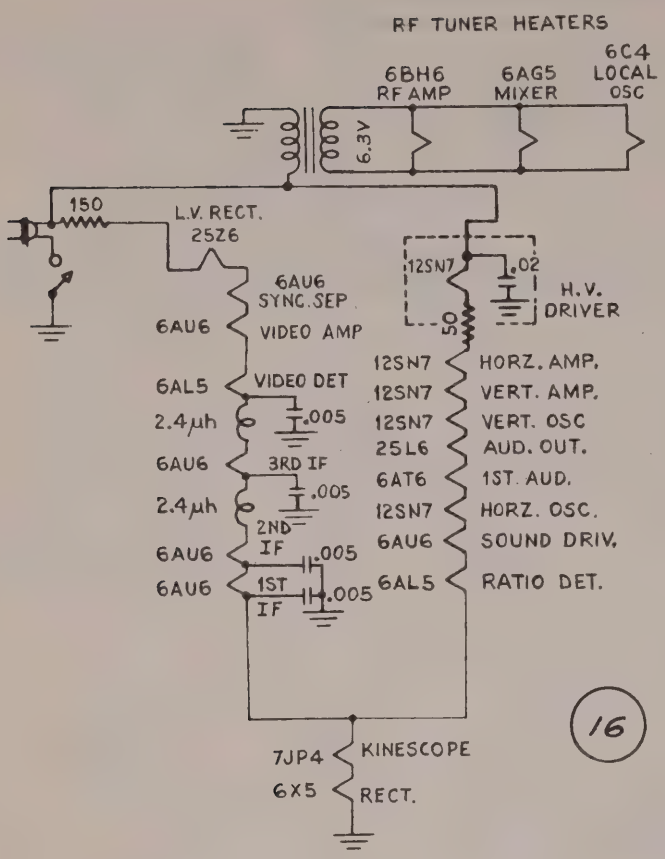
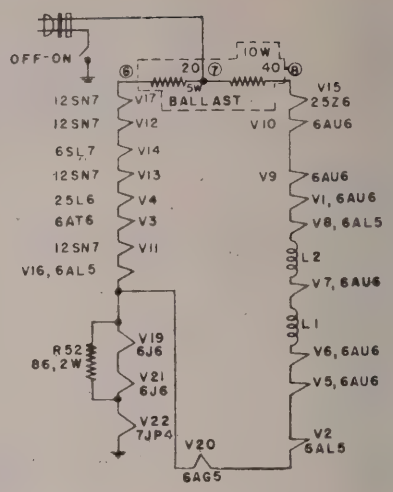




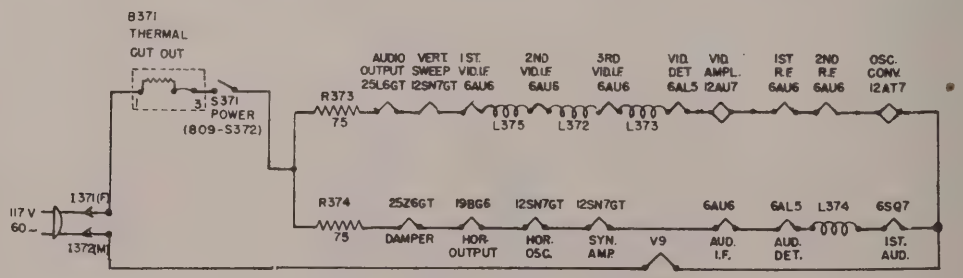

16




| NO | FUNCTION | NO | FUNCTION |
|---|---|---|---|
| V1 | 4.5 MC AMPLIFIER | V12 | HORIZ DEFLECTION AMPLIFIER |
| V2 | RATIO DETECTOR | V13 | VERTICAL OSCILLATOR |
| V3 | AUDIO AMPLIFIER | V14 | VERT DEFLECTION AMPLIFIER |
| V4 | AUDIO OUTPUT | V15 | LOW VOLTAGE RECTIFIER |
| V5 | 1st I.F. AMPLIFIER | V16 | A.F.C. DISCRIMINATOR |
| V6 | 2d I.F. AMPLIFIER | V17 | HIGH VOLTAGE R.F. OSC |
| V7 | 3d I.F. AMPLIFIER | V18 | HIGH VOLTAGE RECTIFIER |
| V8 | VIDEO DETECTOR & A.G.C. | V19 | OSCILLATOR |
| V9 | VIDEO AMPLIFIER | V20 | CONVERTER |
| V10 | SYNC. SEPARATOR & D.C. RESTORER | V21 | R.F. AMPLIFIER |
| V11 | HORIZ. OSC. & A.F.C. AMPLIFIER | V22 | PICTURE TUBE |

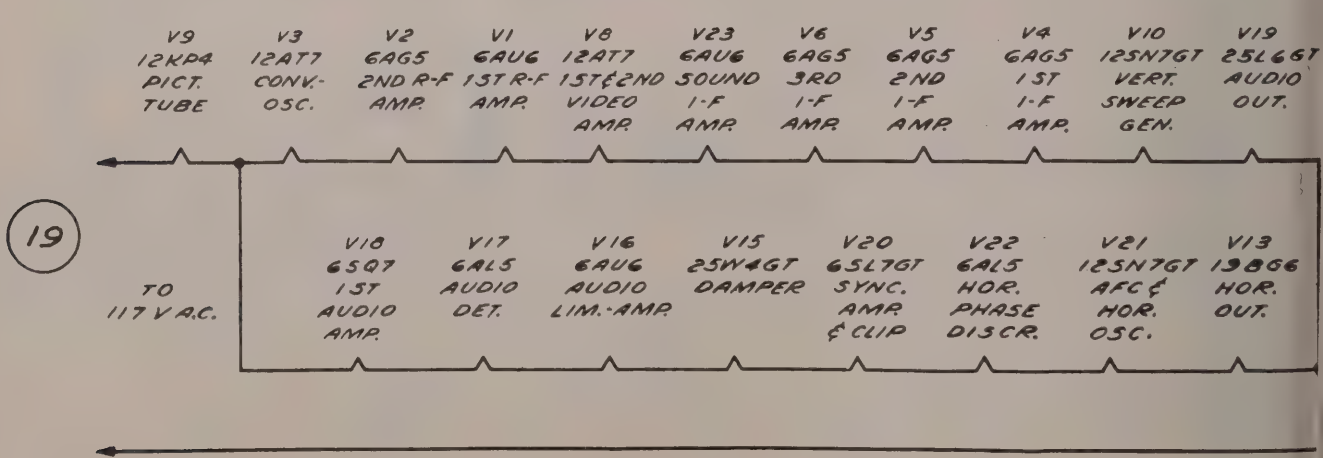
17

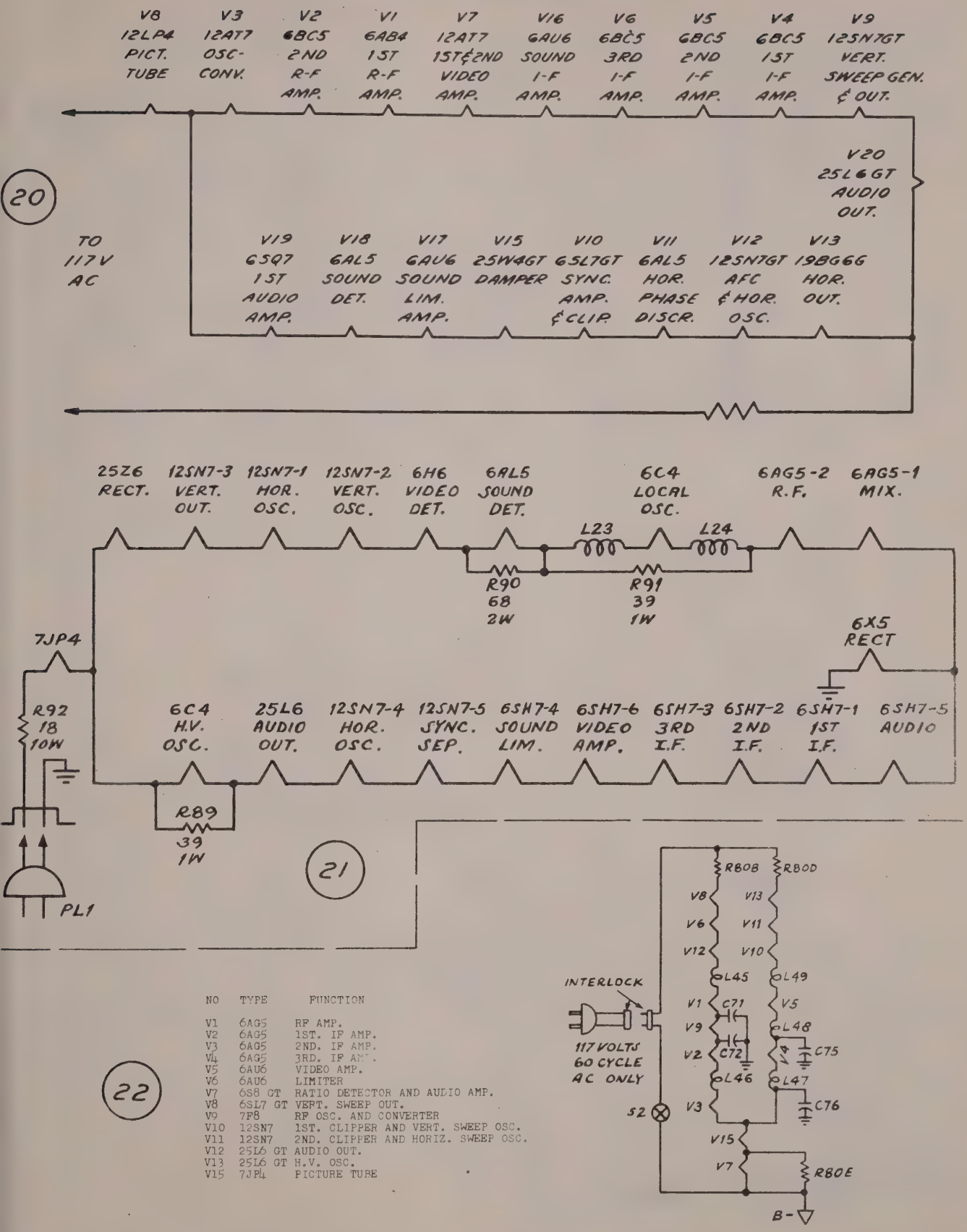
18




10BP4 OR 10FP4

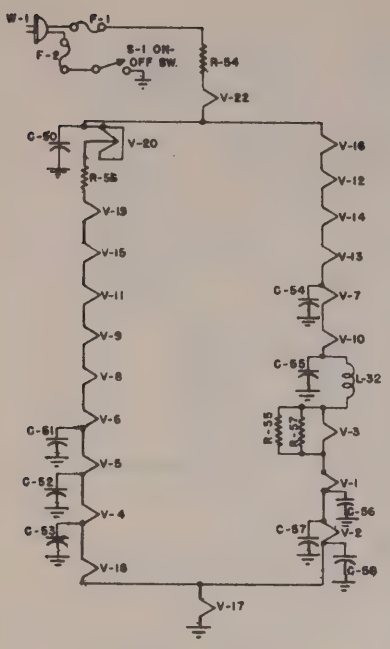
19


V9 12KP4 PICT. TUBE
V3 12AT7 CONV.-OSC.
V2 6AG5 2ND R-F AMP.
V1 6AU6 1ST R-F AMP.
V8 12AT7 1ST & 2ND VIDEO AMP.
V23 6AU6 SOUND I-F AMP.
V6 6AG5 3RD I-F AMP.
V5 6AG5 2ND I-F AMP.
V4 6AG5 1ST I-F AMP.
V10 12SN7GT VERT. SWEEP GEN.
V19 25L6GT AUDIO OUT.
TO 117 V A.C.
V18 6SQ7 1ST AUDIO AMP.
V17 6AL5 AUDIO DET.
V16 6AU6 AUDIO LIM.-AMP.
V15 25W4GT DAMPER
V20 6SL7GT SYNC. AMP. & CLIP
V22 6AL5 HOR. PHASE DISCR.
V21 12SN7GT AFC & HOR. OSC.
V13 19BG6 HOR. OUT.



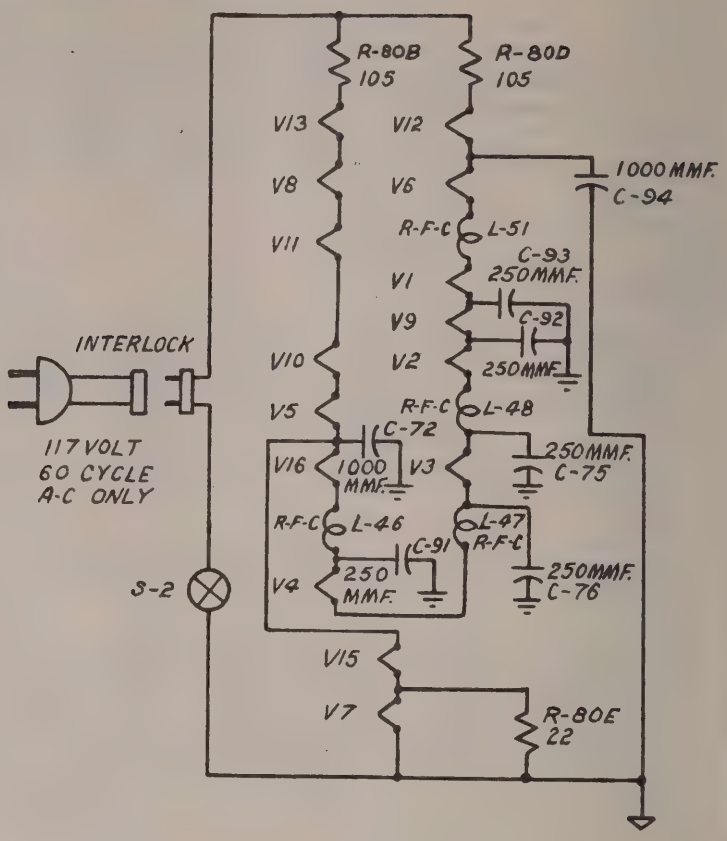

22

| NO | TYPE | FUNCTION |
|---|---|---|
| V1 | 6AG5 | RF AMP. |
| V2 | 6AG5 | 1ST. IF AMP. |
| V3 | 6AG5 | 2ND. IF AMP. |
| V4 | 6AG5 | 3RD. IF AMP. |
| V5 | 6AU6 | VIDEO AMP. |
| V6 | 6AU6 | LIMITER |
| V7 | 6S8 GT | RATIO DETECTOR AND AUDIO AMP. |
| V8 | 6SL7 GT | VERT. SWEEP OUT. |
| V9 | 7F8 | RF OSC. AND CONVERTER |
| V10 | 12SN7 | 1ST. CLIPPER AND VERT. SWEEP OSC. |
| V11 | 12SN7 | 2ND. CLIPPER AND HORIZ. SWEEP OSC. |
| V12 | 25L6 GT | AUDIO OUT. |
| V13 | 25L6 GT | H.V. OSC. |
| V15 | 7JP4 | PICTURE TUBE |




| | Tube | Function |
|---|---|---|
| V1 | 6AU6 | R.F. Amplifier |
| V2 | 6AG5 | Mixer |
| V3 | 6C4 | Local Oscillator |
| V4 | 6AU6 | First Video I.F. Amplifier |
| V5 | 6AU6 | Second Video I.F. Amplifier |
| V6 | 6AU6 | Third Video I.F. Amplifier |
| V7 | 6AL5 | Video Detector—Automatic Gain Control |
| V8 | 6AU6 | Video Amplifier |
| V11 | 6AU6 | Sync Clipper—D.C. Restorer |
| V9 | 6AU6 | 4.5 Mc. Ratio Detector Driver |
| V10 | 6AL5 | Ratio Detector |
| V18 | 6AT6 | Audio Amplifier |
| V19 | 25L6GT/G | Audio Output |
| V13 | 12SN7GT | Vertical Sweep Generator |
| V12 | 12SN7GT | Vertical Sweep Output |
| V15 | 12SN7GT | Horizontal Sweep Generator |
| V14 | 12SN7GT | Horizontal Sweep Output |
| V20 | 12AU7 | R.F. High Voltage Oscillator |
| V21 | 1B3GT/8016 | High Voltage Rectifier |
| V16 | 25Z6GT/G | Low Voltage Doubler—B Minus Voltage Rectifier |
| V17 | 6X5GT/G | Voltage Multiplier |
| V22 | 7JP4 | Picture Tube |

23

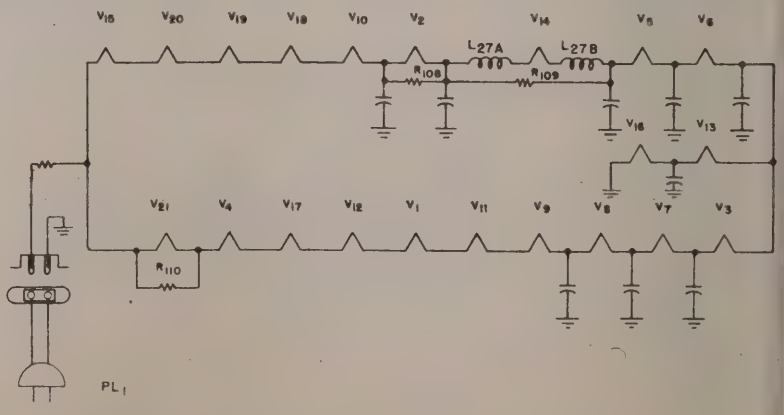



| NO | TYPE | FUNCTION |
|---|---|---|
| V1 | 6AG5 | RF AMP. |
| V2 | 6AG5 | 1ST. VIDEO IF AMP. |
| V3 | 6AG5 | 2ND. VIDEO IF AMP. |
| V4 | 6AG5 | 3RD. VIDEO IF AMP. |
| V5 | 6AU6 | VIDEO AMP. |
| V6 | 6AU6 | LIMITER |
| V7 | 6SQ7 | AUDIO AMP. |
| V8 | 6SL7GT | VERT. SWEEP OUT. |
| V9 | 7F8 | RF OSC. AND CONVERTER |
| V10 | 12SN7GT | 1ST. CLIPPER AND VERT. SWEEP OSC. |
| V11 | 12SN7GT | 2ND. CLIPPER AND HOR. SWEEP OSC. |
| V12 | 25L6GT | AUDIO OUT. |
| V13 | 25L6GT | H.V. SUP. OSC. |
| V15 | 7JP4 | PICTURE TUBE |
| V16 | 6AL5 | RATIO DET. |

24

| NO | TYPE | FUNCTION |
|---|---|---|
| V1 | 6SH7 | AUDIO IF |
| V2 | 6AL5 | FM-DET. |
| V3 | 6SH7 | AUDIO AMP. |
| V4 | 25L6GT | AUDIO OUTPUT |
| V5 | 6AG5 | RF AMP. |
| V6 | 6AG5 | MIXER |
| V7 | 6SH7 | 1ST. IF |
| V8 | 6SH7 | 2ND. IF |
| V9 | 6SH7 | 3RD. IF |
| V10 | 6H6 | VIDEO DET. |
| V11 | 6SH7 | VIDEO AMP. |
| V12 | 12SN7GT | VIDEO OUT.,SYNC.SEP.,DC REST. |
| V13 | 7JP4 | KINESCOPE |
| V14 | 6C4 | OSCILLATOR |
| V15 | 25Z6GT | RECTIFIER |
| V16 | 6X5 | RECTIFIER |
| V17 | 12SN7GT | HORIZONTAL OSCILLATOR |
| V18 | 12SN7GT | VERTICAL OSCILLATOR |
| V19 | 12SN7GT | HORIZONTAL AMPLIFIER |
| V20 | 12SN7GT | VERTICAL AMPLIFIER |
| V21 | 6C4 | H.V. OSC. |

25



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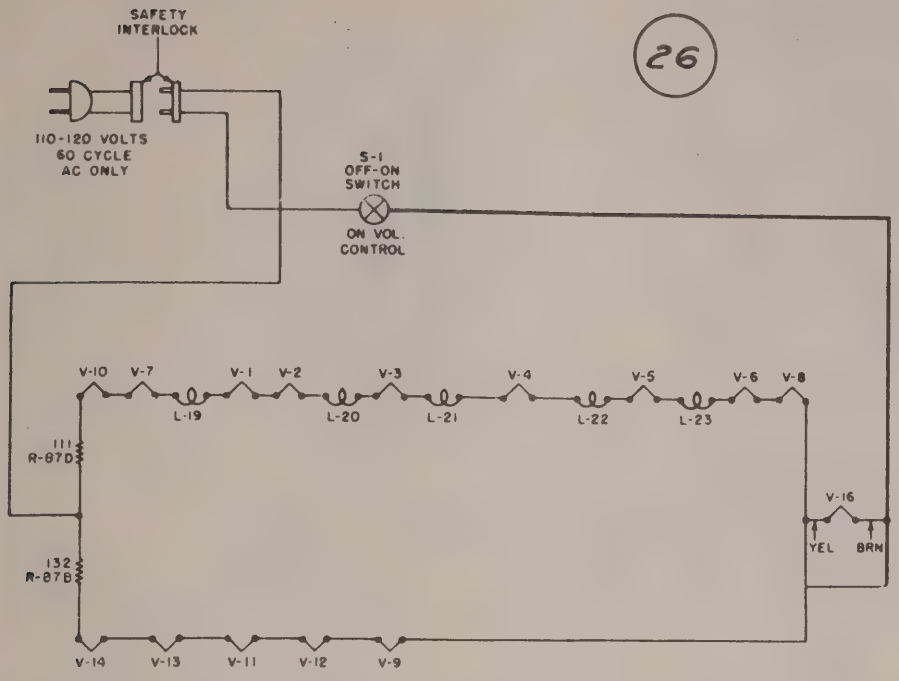
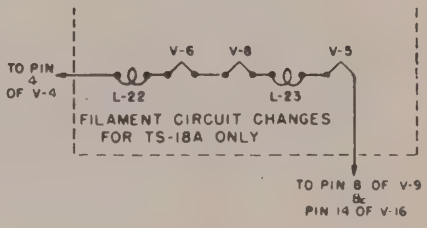



| NO | TYPE | FUNCTION |
|---|---|---|
| V1 | 6AG5 | RF AMP. |
| V2 | 12AT7 | MIXER OSC. |
| V3 | 6AU6 | 1ST IF AMP. |
| V4 | 6AU6 | 2ND IF AMP. |
| V5 | 6AU6 | 3RD IF AMP. |
| V6 | 6AU6 | VIDEO AMP. |
| V7 | 6AU6 | AUDIO DRIVER-LIMITER |
| V8 | 6AL5 | RATIO DETECTOR |
| V9 | 12SN7 | 1ST AUDIO AMP.,VERT.SWEEP OSC. |
| V10 | 25L6 | AUDIO OUTPUT |
| V11 | 12SN7 | 1ST & 2ND CLIPPER |
| V12 | 12SN7 | HOR.OSC.& AFC DIODE |
| V13 | 6SL7 | VERT. SWEEP OUTPUT |
| V14 | 25L6 | H.V. OSC. |
| V16 | 7JP4 | PICTURE TUBE |
| | 8BP4 | |

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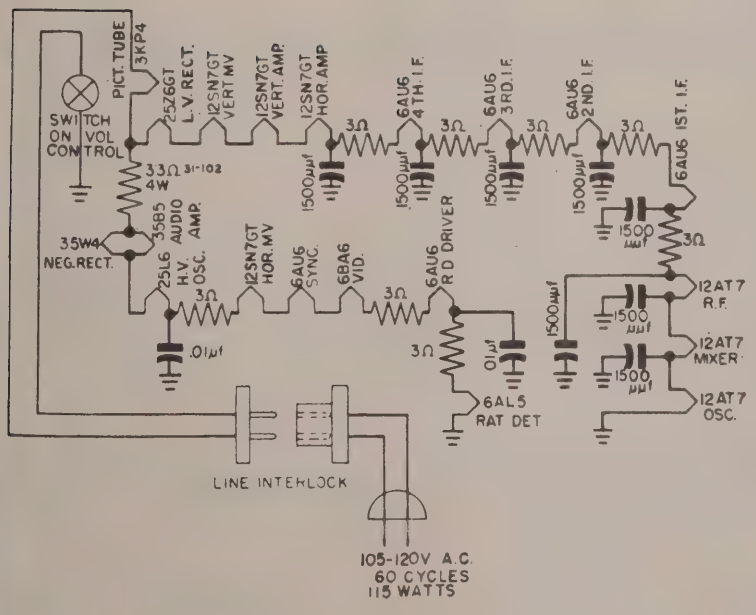


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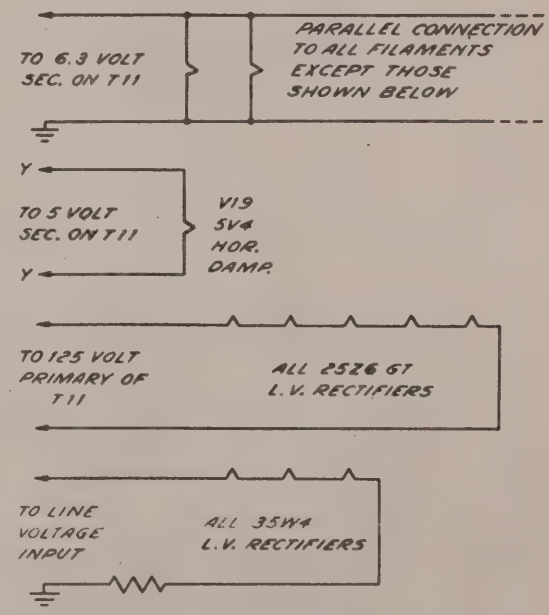
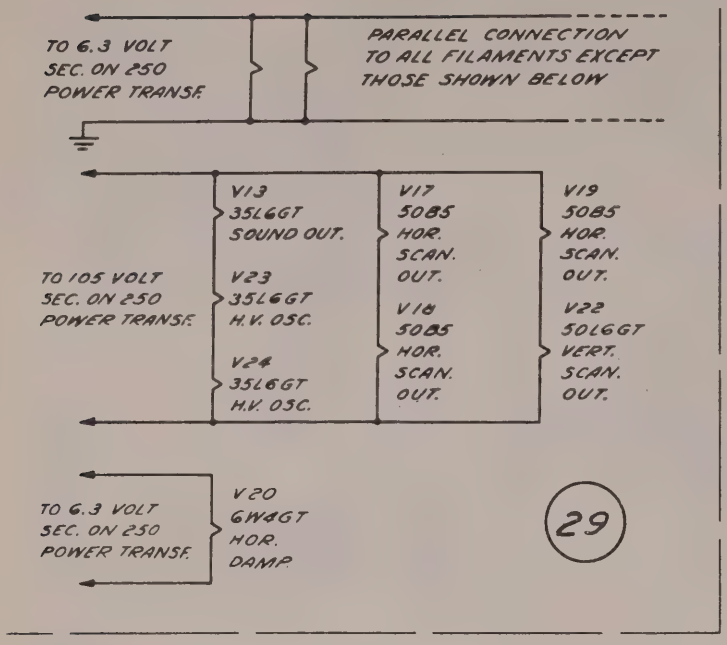
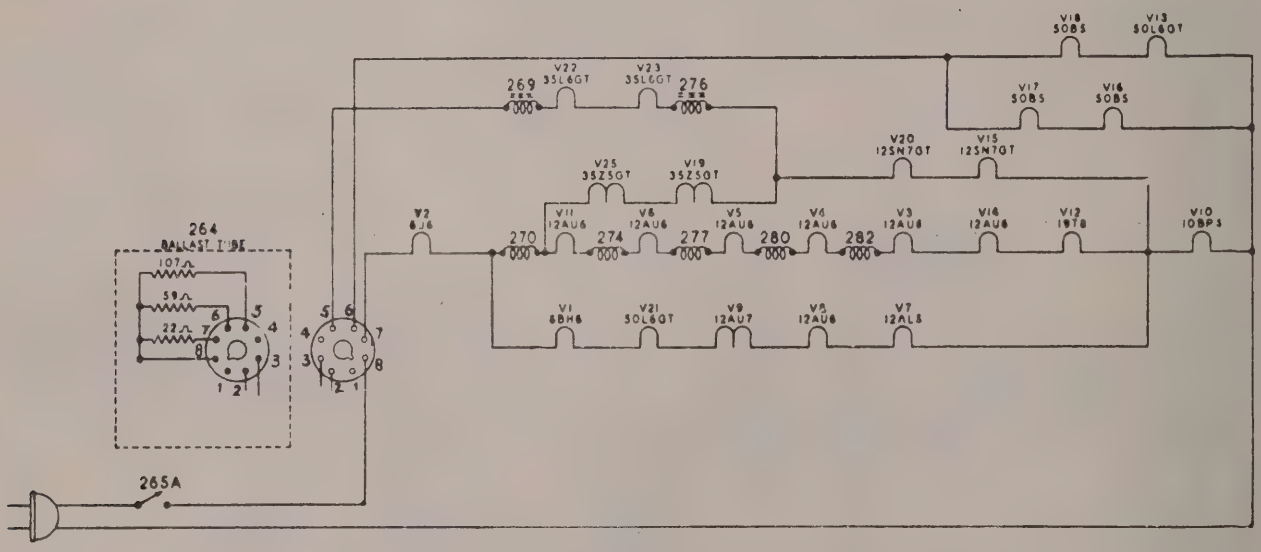

TO 6.3 VOLT SEC. ON T11
PARALLEL CONNECTION TO ALL FILAMENTS EXCEPT THOSE SHOWN BELOW
TO 5 VOLT SEC. ON T11
V19 5V4 HOR. DAMP.
TO 125 VOLT PRIMARY OF T11
ALL 2526 GT L.V. RECTIFIERS
TO LINE VOLTAGE INPUT
ALL 35W4 L.V. RECTIFIERS

NOTE:
MODEL 506-B (TIBET) RADIO CHASSIS FILAMENTS ARE IN PARALLEL ARRANGEMENT.

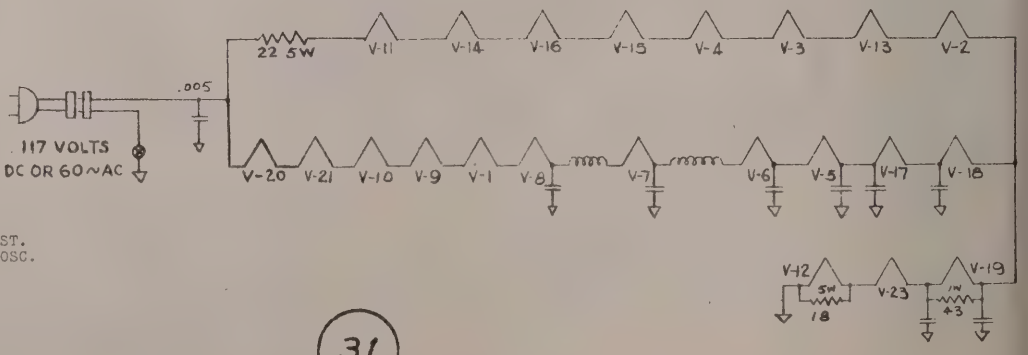

TO 6.3 VOLT SEC. ON 250 POWER TRANSF.
PARALLEL CONNECTION TO ALL FILAMENTS EXCEPT THOSE SHOWN BELOW
TO 105 VOLT SEC. ON 250 POWER TRANSF.
V13 35L6GT SOUND OUT.
V23 35L6GT H.V. OSC.
V24 35L6GT H.V. OSC.
V17 50B5 HOR. SCAN. OUT.
V18 50B5 HOR. SCAN. OUT.
V19 50B5 HOR. SCAN. OUT.
V22 50L6GT VERT. SCAN. OUT.
TO 6.3 VOLT SEC. ON 250 POWER TRANSF.
V20 6W4GT HOR. DAMP
29

| NO | TYPE | FUNCTION |
|---|---|---|
| V1 | 6BH6 | RF AMP. |
| V2 | 6J6 | MIXER-OSC. |
| V3 | 12AU6 | 1ST. IF AMP. |
| V4 | 12AU6 | 2ND. IF AMP. |
| V5 | 12AU6 | 3RD. IF AMP. |
| V6 | 12AU6 | 4TH. IF AMP. |
| V7 | 12AL5 | DET. AGC |
| V8 | 12AU6 | VIDEO AMP. |
| V9 | 12AU7 | DC REST., HOR. SCAN. MVBTR. |
| V10 | 10BP4 | PICTURE TUBE |
| V11 | 12AU6 | SOUND IF AMP. AND LIM. |
| V12 | 19T8 | DYN. LIM., SOUND DISCR., SOUND AMP. |
| V13 | 50L6GT | SOUND OUT. |
| V14 | 12AU6 | SYNC. CLIP. |
| V15 | 12SN7GT | HOR. SCAN. MVBTR. AND AMP. |
| V16 | 50B5 | HOR. SCAN. OUT. |
| V17 | 50B5 | HOR. SCAN. OUT. |
| V18 | 50B5 | HOR. SCAN. OUT. |
| V19 | 35Z5GT | HOR. DAMP. |
| V20 | 12SN7GT | VERT. SCAN. MVBTR. |
| V21 | 50L6GT | VERT. SCAN. OUT. |
| V22 | 35L6GT | H.V. OSC. |
| V23 | 35L6GT | H.V. OSC. |
| V25 | 35Z5GT | L.V. RECT. |

30




| NO | TYPE | FUNCTION |
|---|---|---|
| V1 | 6AU6 | AUDIO IF |
| V2 | 6AL5 | RATIO DET. |
| V3 | 6AT6 | AUDIO AMP. |
| V4 | 25L6 | AUDIO OUT. |
| V5 | 6AU6 | 1ST. VIDEO IF |
| V6 | 6AU6 | 2ND. VIDEO IF |
| V7 | 6AU6 | 3RD. VIDEO IF |
| V8 | 6AL5 | VIDEO DET. |
| V9 | 6AU6 | VIDEO AMP. |
| V10 | 6AU6 | SYNC. SEP. AND DC REST. |
| V11 | 12SN7 | SYNC. AMP. AND HOR. OSC. |
| V12 | 6H6 | HOR. SYNC. DISCR. |
| V13 | 12SN7 | HOR. OSC. AND DISCH. |
| V14 | 12SN7 | HOR. OUT. |
| V15 | 12SN7 | VERT. OSC. |
| V16 | 6SL7 | VERT. AMP. |
| V17 | 6AU6 | RF AMP. |
| V18 | 6A05 | CONVERTER |
| V19 | 6J6 | RF OSC. |
| V20 | 25L6 | H.V. OSC. |
| V21 | 25L6 | H.V. OSC. |
| V23 | 7JP4 | PICTURE TUBE |

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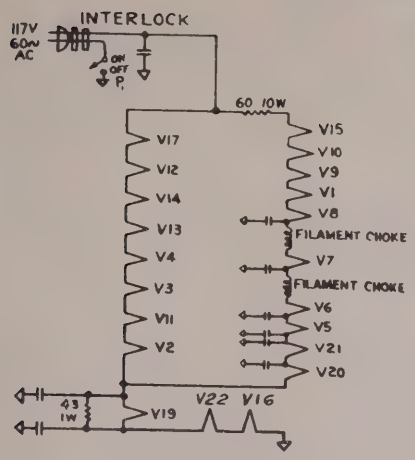
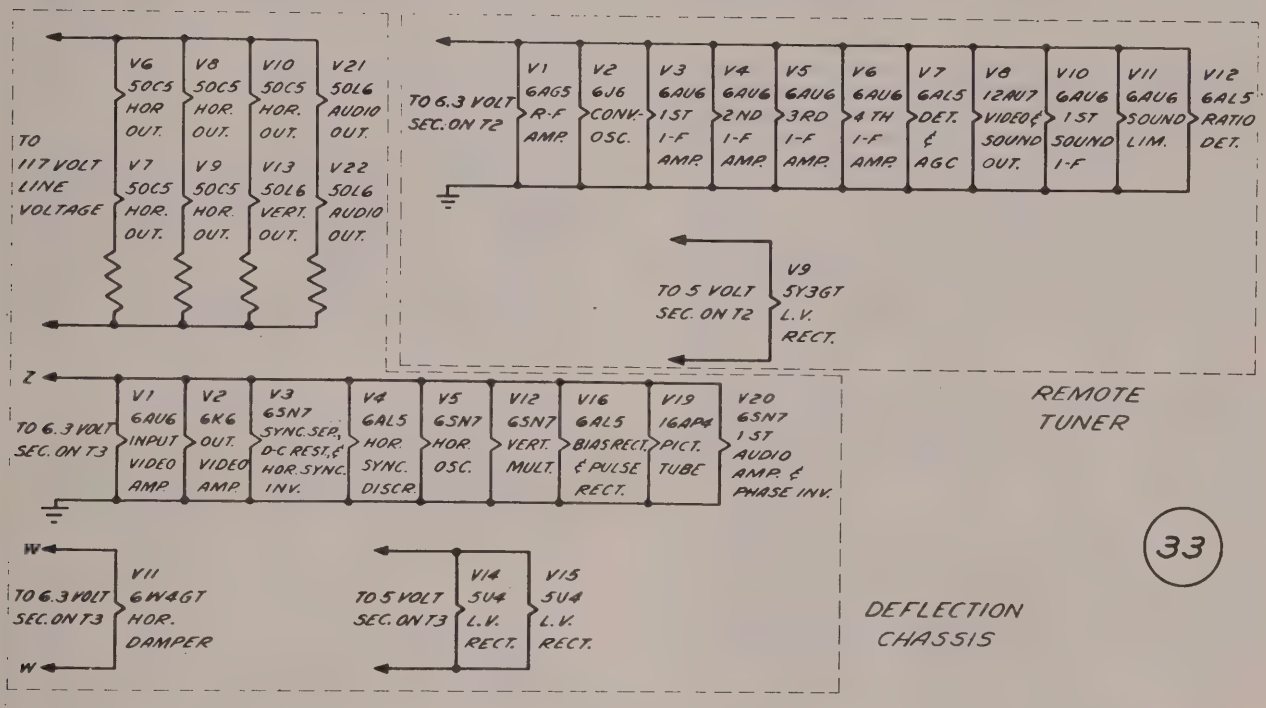



32

| NO | TYPE | FUNCTION |
|---|---|---|
| V1 | 6AU6 | AUDIO IF |
| V2 | 6AL5 | RATIO DET. |
| V3 | 6AT6 | AUDIO AMP. |
| V4 | 25L6 | AUDIO OUT. |
| V5 | 6AU6 | 1ST. VIDEO IF |
| V6 | 6AU6 | 2ND. VIDEO IF |
| V7 | 6AU6 | 3RD. VIDEO IF |
| V8 | 6AL5 | VIDEO DET.AND AGC DIODE |
| V9 | 6AU6 | VIDEO AMP. |
| V10 | 6AU6 | SYNC. SEP. AND DC REST. |
| V11 | 12SN7 | HOR. OSC. |
| V12 | 12SN7 | HOR. AMP. |
| V13 | 12SN7 | VERT. OSC. |
| V14 | 12SN7 | VERT. AMP. |
| V15 | 25Z6 | L.V. RECT. |
| V16 | 6X5 | VOLTAGE DOUBLER |
| V17 | 12SN7 | H.V. OSC. |
| V19 | 6J6 | RF OSC. |
| V20 | 6AG5 | CONVERTER |
| V21 | 6AU6 | RF AMP. |
| V22 | 7JP4 | PICTURE TUBE |


TO 117 VOLT LINE VOLTAGE
V6 50C5 HOR. OUT.
V8 50C5 HOR. OUT.
V10 50C5 HOR. OUT.
V21 50L6 AUDIO OUT.
V7 50C5 HOR. OUT.
V9 50C5 HOR. OUT.
V13 50L6 VERT. OUT.
V22 50L6 AUDIO OUT.
TO 6.3 VOLT SEC. ON T2
V1 6AG5 R-F AMP.
V2 6J6 CONV.-OSC.
V3 6AU6 1ST I-F AMP.
V4 6AU6 2ND I-F AMP.
V5 6AU6 3RD I-F AMP.
V6 6AU6 4TH I-F AMP.
V7 6AL5 DET. & AGC
V8 12AU7 VIDEO & SOUND OUT.
V10 6AU6 1ST SOUND I-F
V11 6AU6 SOUND LIM.
V12 6AL5 RATIO DET.
TO 5 VOLT SEC. ON T2
V9 5Y3GT L.V. RECT.
REMOTE TUNER
Z
TO 6.3 VOLT SEC. ON T3
V1 6AU6 INPUT VIDEO AMP.
V2 6K6 OUT. VIDEO AMP.
V3 6SN7 SYNC. SEP., D-C REST. & HOR. SYNC. INV.
V4 6AL5 HOR. SYNC. DISCR.
V5 6SN7 HOR. OSC.
V12 6SN7 VERT. MULT.
V16 6AL5 BIAS RECT. & PULSE RECT.
V19 16AP4 PICT. TUBE
V20 6SN7 1ST AUDIO AMP. & PHASE INV.
W
TO 6.3 VOLT SEC. ON T3
V11 6W4GT HOR. DAMPER
W
TO 5 VOLT SEC. ON T3
V14 5U4 L.V. RECT.
V15 5U4 L.V. RECT.
DEFLECTION CHASSIS

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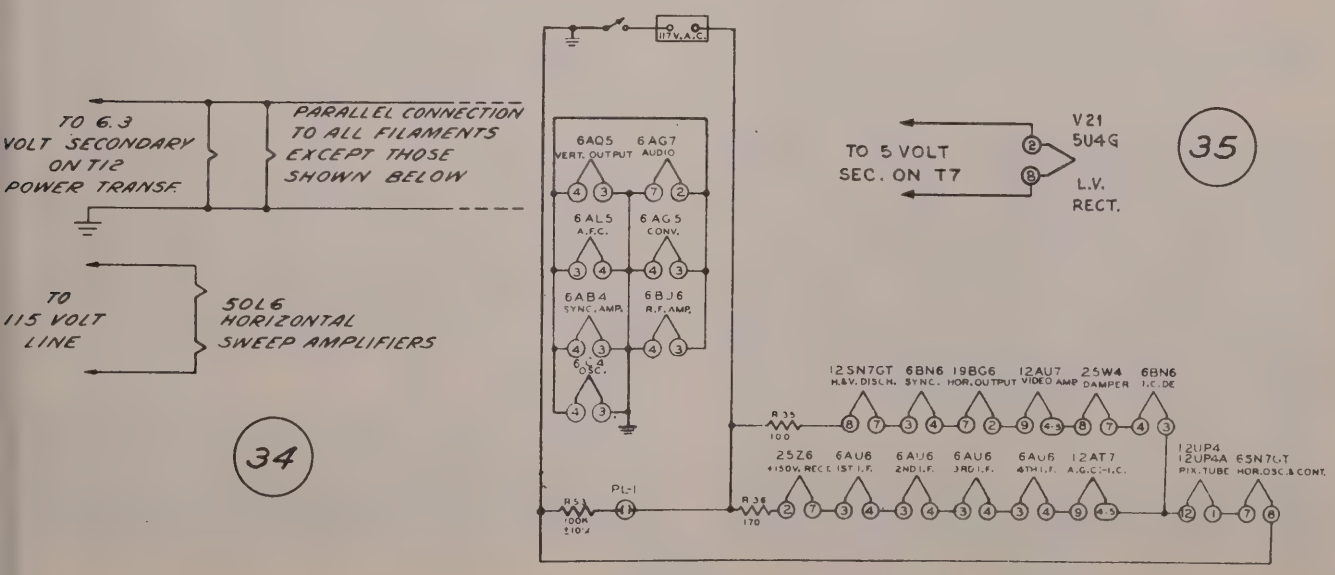


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# SECTION 4

SERVICING SUGGESTIONS

Suggestions For Making Adapters

When they are available, the manufacturer's bases and sockets are the thing to use in making adapters but,when this material is not to be had,we have found the following methods very practical.

There is a molded octal socket sold everywhere, which, with the tinned metal mounting removed, fits into the top of a bakelite octal tube base as if made for the purpose. No. 24 or 26 wires are soldered to the socket and pulled down through the tube base pins, soldered and cut off. Bits of spaghetti should be used to avoid shorts. In the case of 12K7 and other tubes with top caps,a hole is drilled in the side of the base opposite the grid pin. A flexible wire with grid clip is brought out through this hole to connect the top cap. In case of substituting a loctal for an octal such as the 1LA6 for 1A7 the grid lead from tube socket is brought out through this hole to connect the top cap.

In case of substituting a loctal for an octal such as the 1LA6 for 1A7,the grid lead from the tube socket is brought out through the side of the base and an old tube cap soldered on. Always select bakelite bases with eight pins. Most octal tubes have only 7 pins or less, but pin 6 is needed in most adapters.

Another, and we believe, better way to make adapters is to remove the 8 pin wafers from the bases of metal tubes. Use No. 18 tinned wire soldering them in the pins first, preferably by dipping, then bend each one so that it will meet the terminal lug on whatever kind of socket is necessary. All of the socket terminal lugs sit down on the bakelite ridge around the wafer and the wires hold them firmly in place.

If 1R5 tubes are comparatively plentiful and 1A7's are impossible to secure, an adapter can be made easily and quickly as follows:

Select an 8 pin octal base with metal band. With the pliers remove the metal, leaving the bottom wafer and pins. Cut 5 pieces of No. 18 tinned wire 1 1/4 inches long, dropping them down into pins 2, 3, 5, 6, and 7, bending them over enough to avoid their falling through and then solder the ends. Put a piece of spaghetti 3/8 inch long on the wire from pin 6 and bend it flat down on the wafer and across to the pin 3, then straight up. Push the wires through holes in miniature socket lugs as shown in substitution data, bend wires outward and down, then cut off close, clinch with pliers and solder. This makes a rugged adapter with very little danger of shorts. The same procedure is followed in making an adapter to use a 1T4 in place of a 1N5. An 8 pin wafer from the base of a metal tube also makes a good adapter.

Adapters are best soldered by dipping. Melt enough solder in a very small pan or tin can lid over an electric or gas hot plate to just touch the ends of the pins on an octal base when the guide pin is on the bottom. Use a quarter-inch dowel pin or piece of shaft,pushing it down inside the guide pin so that it can be used as a handle. Dip the pins for 3 or 4 seconds then lift it out and dip the ends of the pins in water to cool them quickly. This is very much faster and better than doing it one pin at a time with a soldering iron.

To Repair the Filaments in 150 Ma Tubes
(For Emergency Use Only)

Many 150-ma heater tubes can be made to give additional service after they have been burned out, that is, after the filament is open. The necessary parts are: a power transformer with a 50-ma secondary that will deliver 750 volts across the high-voltage winding, seven octal sockets, two loctal sockets, and a chassis pan with room enough to mount them. The connections are very simple, as illustrated in the diagram of Fig. 4-1, and require less than two hours to assemble.

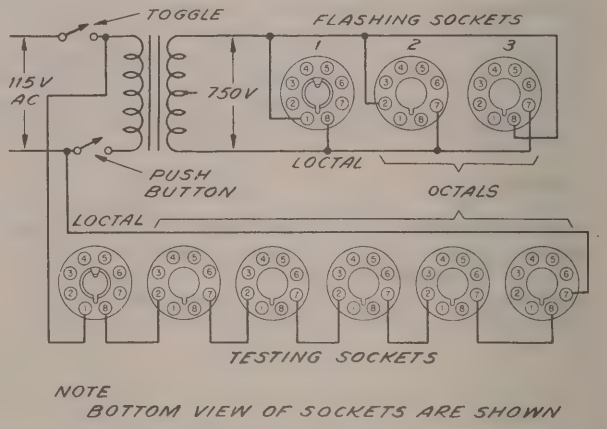


FIG. 4-1. Illustrating the setup for filament repair.

We have found by experience that putting the push button in the primary side of the transformer, in addition to protecting the operator from shocks, causes a hotter starting arc to weld the broken filament. The six sockets connected in series are for testing the repaired tubes. Put enough tubes in series to make as close as possible to 115 volts and short the filament connections on the remaining sockets that are left empty. Number 3 octal socket is for a 12SQ7, 6SQ7, and a few other types which have their heater connections on pins 7 and 8.

The operation is as follows. Insert the line plug, turn on the switch, and place the tube to be repaired in the proper socket. A low-wattage lamp drawing current from the same electric circuit should be in front of the operator. Press the button quickly, making as short a contact as possible. If the lamp dims, you have welded the ends of the

heater together. If they are not welded, press the button several more times, while snapping at the tube with the fingers of the other hand. If this does not weld the filaments, allow three seconds to elapse when working with metal tubes and then push the button again. Repeat this, then wait ten seconds and press for the last time. The switch contact should be as short as possible each time.

For 6- and 12-volt glass tubes, the same procedure is employed except that you must observe the tube and continue to press the button at intervals until the filament shows light. For higher voltage tubes such as 50L6, 35L6, 35A5, etc. the button must be held down slightly longer. Success has been obtained in repairing about forty percent of burned out 150-ma heater tubes which include 12SA7, 12SK7, 12SQ7, 50L6, 35Z5, and almost all other 12-, 14-, 35-, and 50-volt heater tubes. The filaments of tubes having current ratings of less than 150 ma will be completely destroyed when burned in this apparatus, and tubes with high current ratings will overload the transformer severely, although in some cases a repair can be made. If the results are not satisfactory, try using a different transformer. Our experience shows, however, that a 750-volt secondary is the most satisfactory.

We have had many inquiries about the low-wattage lamp mentioned above. This lamp should be not larger than 40 watts and does not have to be connected to the apparatus. It may be the light in the shop where you are working and serves only to show you when the current has welded the ends of the broken filament in a metal tube. When the high voltage passes through the filament, there is a surge of current lasting only a very small fraction of a second. The transformer draws a rather large amount of current from the electric light line, pulling the voltage down and causing the light to blink or flicker. It is not needed in the case of glass tubes since you are able to see when the filament lights.

The average life of repaired tubes is short. We describe this process for use only in case of emergency and in no case recommend the use of a repaired tube when a new one is available. Even when the tube is not available, a repaired tube should be burned for at least one hour before putting it in a customer's radio.

### 35Z5 Tubes

Possibly most service men know this, but it will bear repeating for the benefit of those who do not. The 35Z5 filament is between pins 2 and 7 with a tap brought out to pin 3. This tap is about 5 volts, from pins 2 to 3 and provides current for the pilot light. Operating the radio with burned out pilot light causes this section to burn out and breaks the filament circuit. Pins 2 and 3 may be shorted together so as to use the remaining 30-volt filament and the tube may still give long service. Check every burned out 35Z5, and if there is continuity between pins 3 and 7, the tube is still usable.

If it is necessary to use the pilot light, connect a 25- to 30-ohm resistor from pins 3 to 2, either on the tube base (be careful that it does not short to metal chassis) or on the socket terminals, and the pilot light will light as usual.

### Substitution of Complete Sets of Tubes

Most of the popular 12-, 35-, and 50-volt tubes now in use are nearing the end of their lives. Often a customer comes in and pays for a substitute tube and the necessary rewiring job, only to be back again within a week or ten days with another "impossible to get" tube burned out. He may again go to considerable expense to replace that one and have the same thing happen again.

Since most of the 6- and 25-volt, 0.3-ampere tubes are comparatively plentiful, a complete changeover job is more practical and satisfactory. Replace 12SA7 with 6SA7, 12SK7 with 6SK7, 12SQ7 with 6SQ7, 50L6 or 35L6 or any of the other 25-volt, 0.3-ampere output tubes, and 25Z5 with 25Z6. The only necessary changes are in connection with the rectifier tube and replacement of the a-c line cord with a line resistor cord of 130 ohms. Red goes to the switch and black to pins 3 and 5 of the 35Z5 socket after removing the pilot light wire from pin 3. Any wire on pin 4 is removed and taped up, 4 is connected to 8, the line cord resistor and a 25-ohm resistor are connected to the wire from pin 3 and the other end of resistor to pin 2.

### Changing Battery-Operated Radios For Electric Operation

This is not a job for the novice, but any experienced radio serviceman can make the change with very satisfactory results if there is room on the chassis for an additional tube.

First find a location for the rectifier tube, drill a hole and mount the socket. Remove all battery wires. Connect one side of the line cord to pins 2, 3, and 5 of a 117Z6 socket; connect the other side of the cord to the A battery switch, ground the other side of the switch and also pin 7 of the 117Z6.

From pins 4 and 8, the cathodes of the rectifier, connect a 1-w, 1,500-ohm resistor, R1, to the screen grid of the 3Q5 tube or whatever output tube is used. This is the filter resistor and must have a 20-mf, 150-volt capacitor, C1, from each end of the resistor to ground for 60-cycle operation, or 40 mf for 25-cycle operation.

It is quite likely that you will find one end of each tube filament connected to ground. All of these grounds must be removed and the filaments connected in series as shown in Fig. 4-2. The tubes indicated are for a typical battery-operated receiver. The capacitors and resistors connected to pins 2 and 7 may be left where they are, at least for the present. (We are using pin numbers of octal tubes. If the loctal series is used, the filament pins are usually 1 and 8 instead of 2 and 7. The loctal 1LA6 or 1LC6 is the equivalent of the octal 1A7, the loctal 1LN5 or 1LH4 for the octal 1H5, and the loctal 1LA4 or 1LB4 for the octal 1A5 or 1T5.) If there are more tubes than are shown in the diagram, connect their filaments between the 1N5 and the 1H5.

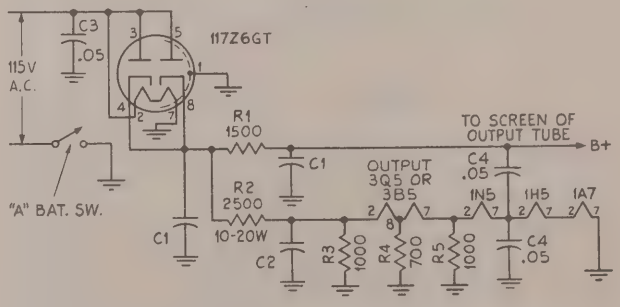


FIG. 4-2. Typical circuit arrangement for changing battery-operated radio to electric operation using a 117Z6GT rectifier tube.

Connect a 2,500-ohm resistor between the rectifier cathodes and one side of the filament of the output tube. This is the filament dropping resistor and has a filter capacitor of from 40 to 200 mf connected between its low

end and ground. This capacitor should be rated at 25 volts because if a tube burns out the voltage rises and might break down a 6- or 12-volt rated capacitor. The filament dropping resistor should be 10 watts if mounted above the chassis and at least 20 watts if mounted underneath where it cannot radiate the heat so readily. There is a 2,200-ohm, 16-w flexible resistor, that seems to be quite plentiful, rather low priced, and is very easy to mount since it is insulated.

Wire in the resistors R4 and R5 permanently, and R3 temporarily as it may have to be changed. If a 1A5 or 1T5 is used instead of the 3Q5 or 3B5, resistor R4 is omitted. The purpose of R4 and R5 is to bypass the current passed from plate to filament in the output tube and to avoid overloading the other filaments.

Now check the grid resistors. The resistor from the grid of the output tube should go directly to ground and each of the others to its own negative filament, pin 7. The lower end of the volume control is connected either directly or through a resistor to ground, or to a filament (which has been disconnected from ground). Leave it where it is for trial; however, if there is distortion, try returning it to the filament circuit between the 1A7 and 1H5 for 1.4-volt bias, or between the 1H5 and 1N5 for 2.8-volt bias, leaving it wherever the tone is best.

Now make up a resistor to take the place of a set of tubes. The resistance of each 1.4-volt filament is approximately 28 ohms, and for the set shown in Fig. 4-2 should be a total of 140 ohms. If it had a 1A5 or 1T5 in the output, the resistance would be 28 ohms less, or 112 ohms. If there should be an additional 1.4-volt tube, it would be 28 ohms more, or 168 ohms. Connect this resistor from pin 2 of the output tube to ground. Put in the rectifier tube, connect the line cord of the set and then turn it on. The voltage across the resistor should be slightly less than 7 volts. If over 7 volts, replace resistor R3 with a lower value. If under 6.2 volts, replace R3 with a higher value. If you have difficulty in getting the correct filament voltage, remember that increasing the capacitance of C1 at the rectifier increases the voltage, and if this capacitor does not have sufficient capacitance you cannot get the correct voltage.

When the voltage has been adjusted, remove resistor R3 and then insert the tubes. The bypass capacitor C4 may already be in the set. If the capacitors are not in and there is a tendency to distort or oscillate, put them in, and make sure that all No. 1 pins of the tubes are grounded to chassis. If the radio does not have a series capacitor in the antenna, it is necessary to put in a 0.01 mf between the antenna and coil to avoid burning out the coil if the antenna should be grounded.

Many other types of rectifiers may be used instead of the 117Z6 which was chosen as the example because it does not require a resistor line cord. For 25Z6, use a line-cord resistor of 300 ohms, connecting red to switch, black to pins 3 and 5, and resistor to pin 2; for 35Z5 and 35Z4 tubes, use a 540-ohm resistor cord, connecting black to pin 5, red to switch, and resistor to pin 2; for a 25Z5 tube, use a 300-ohm cord, connecting red to switch, black to pins 2 and 5, resistor to pin 1, pin 6 to ground, and the filter resistor to pins 3 and 4. These are the most popular rectifiers, but several others may be used with the proper line-cord resistor.

The grounding system and physical factors of the receiver to be worked on should be examined before attempting the changeover. Some bugs may be expected on the first job so do not be discouraged if it does not work perfectly right at first; a little patience in trying to get rid of the bugs will be well rewarded. Remember that the filaments of tubes in most battery-operated radios are only d-c operated. Always check the filament conditions of the tubes with which you are working.

# SECTION 5

## CHARTS AND TABLES

In this section a number of charts and tables are shown that we believe will be very helpful to users of this book. Included in this grouping is a complete listing of receiving tube characteristics and bases and also a separate listing of cathode-ray-tube characteristics and bases. In addition such tabulated matter as RTMA capacitor, resistor, and transformer color codes, ballast tube and resistor numbering codes, pilot lamps, and a cross index of Army VT numbers and commercial vacuum-tube numbers are included. The last named chart will not only help Armed Forces personnel but will be of valuable aid to anyone who has surplus Army tubes and desires to identify the equivalent commercial number for possible use or substitution in commercial equipment.

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### RTMA RECEIVING TUBE RATINGS

It shall be standard to interpret the ratings on receiving types of tubes according to the following conditions:

1. CATHODE

The heater or filament voltage is given as a normal value unless otherwise stated. This means that transformers or resistances in the heater or filament circuit should be designed to operate the heater or filament at rated value for full-load operating conditions under average supply-voltage conditions. A reasonable amount of leeway is incorporated in the cathode design so that moderate fluctuations of heater or filament voltage downward will not cause marked falling off in response; also, moderate voltage fluctuations upward will not reduce the life of the cathode to an unsatisfactory degree.

A. 1.4-VOLT BATTERY TUBE TYPES

The filament power supply may be obtained from dry-cell batteries, from storage batteries, or from a power line. With dry-cell battery supply, the filament may be connected either directly across a battery rated at a terminal potential of 1.5 volts, or in series with the filaments of similar tubes across a power supply consisting of dry cells in series. In either case, the voltage across each 1.4-volt section of filament should not exceed 1.6 volts. With power-line or storage-battery supply, the filament may be operated in series with the filaments of similar tubes.

For such operation, design adjustments should be made so that with tubes of rated characteristics, operating with all electrode voltages applied and on a normal line voltage of 117 volts or on a normal storage-battery voltage of 2.0 volts per cell (without a charger) or 2.2 volts per cell (with a charger), the voltage drop across each 1.4-volt section of filament will be maintained within a range of 1.25 to 1.4 volts with a nominal center of 1.3 volts. In order to meet the recommended conditions for operating filaments in series from dry-battery, storage-battery, or power-line sources it may be necessary to use shunting resistors across the individual 1.4-volt sections of filament.

B. 2.0-VOLT BATTERY TUBE TYPES

The 2.0-volt line of tubes is designed to be operated with 2.0 volts across the filament. In all cases the operating voltage range should be maintained within the limits of 1.8 volts to 2.2 volts.

2. POSITIVE POTENTIAL ELECTRODES

The power sources for the operation of radio equipment are subject to variations in their terminal potential. Consequently, the maximum rating shown on the RTMA Vacuum Tube Data Sheets have been established for certain design center voltages which experience has shown to be representative. The design center voltages to be used for the various power supplies together with other rating considerations are as given below:

A. A-C OR D-C POWER-LINE SERVICE IN U.S.A.

The design center voltage for this type of power supply is 117 volts. The maximum ratings of plate voltages, screen-supply voltages, dissipations, and rectifier output currents are design maximums and should not be exceeded in equipment operated at a line voltage of 117 volts.

B. STORAGE-BATTERY SERVICE

When storage-battery equipment is operated without a charger, it should be designed so that the published RTMA maximum values of plate voltages, screen-supply voltages, dissipations, and rectifier output currents are never exceeded for a terminal potential at the battery source of 2.0 volts per cell. When storage-battery equipment is operated with a charger, it should be designed so that 90% of the same RTMA values are never exceeded for a terminal potential at the battery source of 2.2 volts.

C. "B"-BATTERY SERVICE

The design center voltage "B" batteries is the normal voltage rating of the battery block, such as 45 volts, 90 volts, etc. Equipment should be designed so that under no condition of battery voltage will the plate voltages or dissipations ever exceed the recommended respected maximum values shown in the data for each tube type by more than 10%.

D. OTHER CONSIDERATIONS

1) Class A Amplifiers

The maximum plate dissipation occurs at the "zero-signal" condition. The maximum screen dissipation usually occurs at the condition where the peak-input signal voltage is equal to the bias voltage.

2) Class B Amplifiers

The maximum plate dissipation theoretically occurs at approximately 63% of the "maximum-signal" condition, but may occur practically at any signal voltage value.

3) Converters

The maximum plate dissipation occurs at the "zero-signal" condition and the frequency at which the oscillator-developed bias is a minimum. The screen dissipation for any reasonable variation in signal voltage must never exceed the rated value by more than 10%.

4) Screen Ratings

When the screen voltage is supplied through a series voltage-dropping resistor, the maximum screen voltage rating may be exceeded, provided the maximum screen dissipation rating is not exceeded at any signal condition, and the maximum screen voltage rating is not exceeded, at the maximum-signal condition. Provided these conditions are fulfilled, the screen-supply voltage may be as high as, but not above, the maximum plate voltage rating.

3. TYPICAL OPERATION

For many receiving tubes, the data show typical operating conditions in particular services. These typical operating values are given to show concisely some guiding information for the use of each type. They are not to be considered as ratings, because the tube can be used under any suitable conditions within its rating limitations.

# RECEIVING TUBE BASES

The diagrams on the following pages show standard socket connections corresponding to the base designations given in the column headed "Socket Connections" in the classified tube-data tables. Bottom views are shown throughout. Terminal designations are as follows:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A = Anode | F = Filament | IS = Internal Shield | $P_{BF}$ = Beam-Forming Plates | | repeller |
| B = Beam | G = Grid | K = Cathode | | S = Shell |
| BP = Bayonet Pin | H = Heater | NC = No Connection | RC = Ray-Control Electrode | TA = Target |
| BS = Base sleeve | IC = Internal Connection | P = Plate (Anode) | | ● = Gas-Type Tube |
| D = Deflecting Plate | | $P_1$ = Starter-Anode | Ref = Reflector or | U = Unit |

Alphabetical subscripts D, P, T and HX indicate, respectively, diode unit, pentode unit, triode unit or hexode unit in multi unit types. Subscript M, T or CT indicates filament or heater tap.

Generally when the No. 1 pin of a metal-type tube in Table I, with the exception of all triodes, is shown connected to the shell, the No. 1 pin in the glass (G or GT) equivalent is connected to an internal shield.

## R.M.A. TUBE BASE DIAGRAMS

Bottom views are shown. Terminal designations on sockets are shown above.

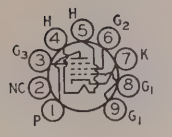
*Courtesy ARRL Handbook*

## R.M.A. TUBE BASE DIAGRAMS

Bottom views are shown.

## R.M.A. TUBE BASE DIAGRAMS

Bottom views are shown.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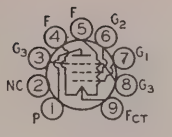
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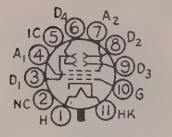
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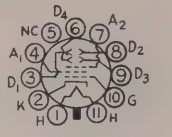
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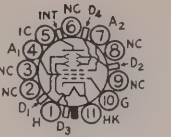
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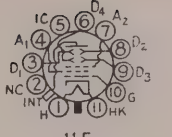
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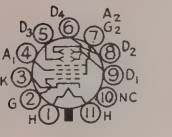
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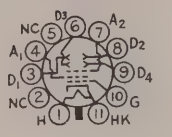
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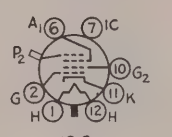
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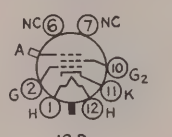
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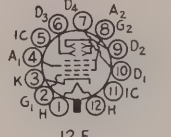
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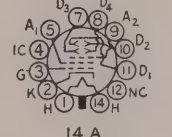
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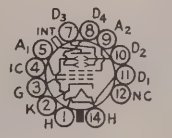
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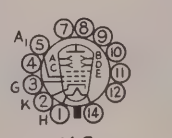
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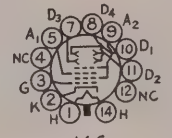

14G

## SUPPLEMENTARY BASE DIAGRAMS

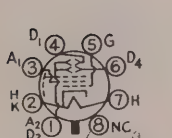


FIG. 1

FIG. 2

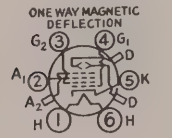
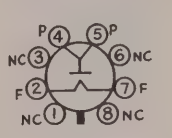


FIG. 3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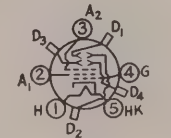
FIG. 6

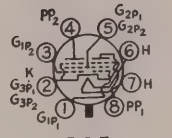
FIG. 7

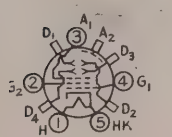
FIG. 8

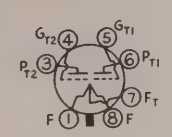
FIG. 9

FIG. 11

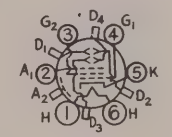
FIG. 12

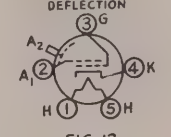
FIG. 13

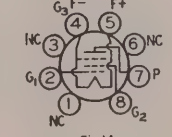
Fig. 14

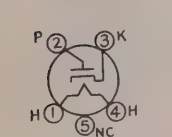
FIG. 15

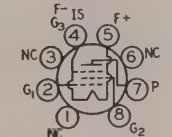
FIG. 16

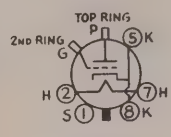
FIG. 17

FIG. 18

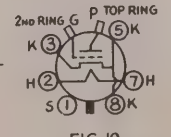
FIG. 19

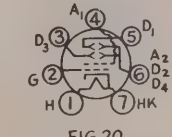
FIG. 20

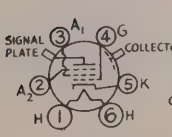
FIG. 21

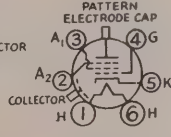
FIG. 22

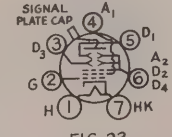
FIG. 23

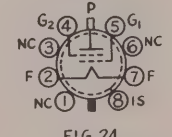
FIG. 24

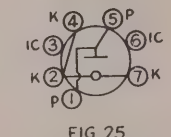
FIG. 25

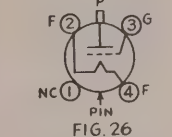
FIG. 26

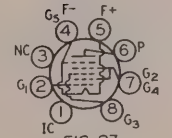
FIG. 27

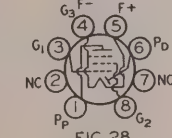
FIG. 28

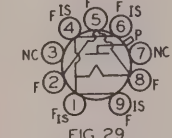
FIG. 29

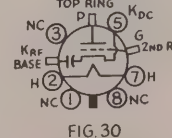
FIG. 30

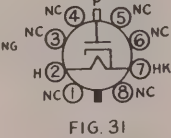
FIG. 31

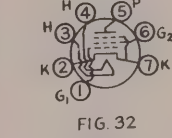
FIG. 32

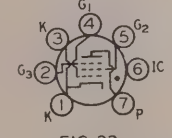
FIG. 33

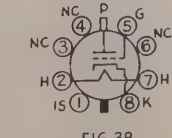
FIG. 38

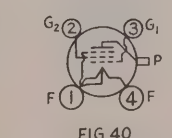
FIG 40

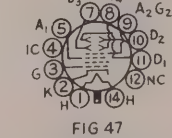
FIG 47

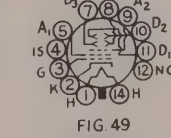
FIG. 49

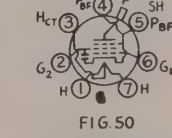
FIG. 50

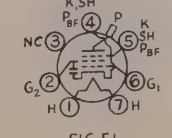
FIG 51

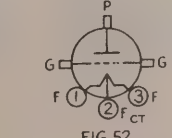
FIG. 52

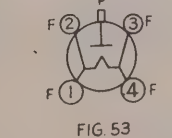
FIG. 53

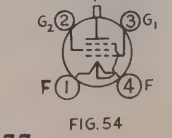
FIG. 54

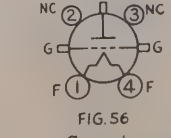
FIG. 56

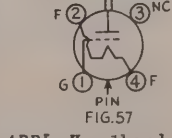
FIG. 57



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## R.M.A. TUBE BASE DIAGRAMS

Bottom views are shown.

## R.M.A. TUBE BASE DIAGRAMS

Bottom views are shown.

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## R.M.A. TUBE BASE DIAGRAMS

Bottom views are shown.

## TABLE I—METAL RECEIVING TUBES

**Characteristics given in this table apply to all tubes having type numbers shown, including metal tubes, glass tubes with "G" suffix, and bantam tubes with "GT" suffix. For "G" and "GT" tubes not listed (not having metal counterparts), see Tables II, VII, VIII and IX.**

| Type | Name | Socket Connections | Fil. or Heater | | Capacitance μμfd. | | | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Volts | Amp. | In | Out | Plate-Grid | | | | | | | | | | | | |
| 6A8 | Pentagrid Converter | 8A | 6.3 | 0.3 | — | — | — | Osc.-Mixer | 250 | — 3.0 | 100 | 3.2 | 3.3 | Anode-grid (No. 2) 250 volts max. thru 20,000 ohms | | | | | 6A8 |
| 6AB7 1853 | Television Amp. Pentode | 8N | 6.3 | 0.45 | 8 | 5 | 0.015 | Class-A Amp. | 300 | — 3.0 | 200 | 3.2 | 12.5 | 700000 | 5000 | 3500 | — | — | 6AB7 1853 |
| 6AC7 1852 | Television Amp. Pentode | 8N | 6.3 | 0.45 | 11 | 5 | 0.015 | Class-A Amp. | 300 | 160* | 150 | 2.5 | 10 | 1000000 | 9000 | 6750 | — | — | 6AC7 1852 |
| 6AG7 | Sharp Cut-off Pentode | 8Y | 6.3 | 0.65 | 13 | 7.5 | 0.06 | Class-$A_1$ Amp. | 300 | — 3.0 | 150 | 7/9 | 30/30.5 | 130000 | 11000 | — | 10000 | 3.0 | 6AG7 |
| 6AJ7 | Sharp Cut-off Pentode | 8N | 6.3 | 0.45 | — | — | — | Class-A Amp. | 300 | 160* | 300 | 2.5 | 10 | 1000000 | 9000 | — | — | — | 6AJ7 |
| 6AK7 | Pentode Power Amp. | 8Y | 6.3 | 0.65 | 13 | 7.5 | 0.06 | Class-A Amp. | 300 | — 3 | 150 | 7 | 30 | 130000 | 11000 | — | 10000 | 3.0 | 6AK7 |
| 6B8 | Duplex-Diode Pentode | 8E | 6.3 | 0.3 | 6 | 9 | 0.005 | Class-A Amp. | 250 | — 3.0 | 125 | 2.3 | 9.0 | 650000 | 1125 | 730 | — | — | 6B8 |
| 6C5 | Triode | 6Q | 6.3 | 0.3 | 3 | 11 | 2 | Class-A Amp. | 250 | — 8.0 | — | — | 8.0 | 10000 | 2000 | 20 | — | — | 6C5 |
| | | | | | | | | Bias Detector | 250 | −17.0 | — | — | Plate current adjusted to 0.2 ma. with no signal | | | | | |
| 6F5 | High-μ Triode | 5M | 6.3 | 0.3 | 5.5 | 4 | 2.3 | Class-A Amp. | 250 | — 1.3 | — | — | 0.2 | 66000 | 1500 | 100 | — | — | 6F5 |
| 6F6 | Pentode Power Amplifier | 7S | 6.3 | 0.7 | 6.5 | 13 | 0.2 | Class-$A_1$ Pent.[5] | 250<br>315 | −16.5<br>−22.0 | 250<br>315 | 6.5<br>8.0 | 36 [7]<br>42 | 80000<br>75000 | 2500<br>2650 | 200<br>200 | 7000<br>7000 | 3.2<br>5.0 | 6F6 |
| | | | | | | | | Class-$A_1$ Triode [1] | 250 | −20.0 | — | — | 34 [7] | 2600 | 2500 | 6.8 | 4000 | 0.85 | |
| | | | | | | | | Class-$AB_2$ Amp.[b]<br>Class-$AB_2$ Amp.[6] | 375<br>375 | 340*<br>−26.0 | 250<br>250 | 8/18<br>5/19.5 | 54/77<br>34/82 | Power output for 2 tubes at stated load, plate-to-plate | | | 10000 [8]<br>10000 [8] | 19.0<br>18.5 | |
| | | | | | | | | Class-$AB_2$ Amp.[1 b] | 350<br>350 | 730*<br>−38 | — | — | 50/61<br>48/92 | — | — | — | 10000 [8]<br>6000 [8] | 9<br>13 | |
| 6H6 | Twin Diode | 7Q | 6.3 | 0.3 | — | — | — | Rectifier | Max. a.c. voltage per plate = 150 r.m.s. Max. output current 8.0 ma. d.c. | | | | | | | | | | 6H6 |
| 6J5 | Triode | 6Q | 6.3 | 0.3 | 3.4 | 3.6 | 3.4 | Class-A Amp. | 250 | — 8.0 | — | — | 9 | 7700 | 2600 | 20 | — | — | 6J5 |
| 6J7 | Sharp Cut-off Pentode | 7R | 6.3 | 0.3 | 7 | 12 | 0.005 | R.F. Amp. | 250 | — 3.0 | 100 | 0.5 | 2.0 | 1.5 meg. | 1225 | 1500 | — | — | 6J7 |
| | | | | | | | | Bias Detector | 250 | — 4.3 | 100 | Cathode current 0.43 ma. | | — | — | 0.5 meg. | — | |
| 6K7 | Variable-μ Pentode | 7R | 6.3 | 0.3 | 7 | 12 | 0.005 | R.F. Amp. | 250 | — 3.0 | 125 | 2.6 | 10.5 | 600000 | 1650 | 990 | — | — | 6K7 |
| | | | | | | | | Mixer | 250 | −10.0 | 100 | — | — | — | Oscillator peak volts = 7.0 | | | | |
| 6K8 | Triode-Hexode | 8K | 6.3 | 0.3 | — | — | — | Converter | 250 | — 3.0 | 100 | 6 | 2.5 | Triode Plate (No. 2) 100 volts, 3.8 ma. | | | | | 6K8 |
| 6L6 | Beam Power Amplifier | 7AC | 6.3 | 0.9 | 10 | 12 | 0.4 | Single Tube Class $A_1$ | 250<br>300 | 170*<br>220* | 250<br>200 | 5.4/7.2<br>3.0/4.6 | 75/78<br>51/54.5 | — | — | — | 2300<br>4500 | 6.5<br>6.5 | 6L6 |
| | | | | | | | | Single Tube Class $A_1$ | 250<br>350 | −14.0<br>−18.0 | 250<br>250 | 5.0/7.3<br>2.5/7.0 | 72/79<br>54/66 | 22500<br>33000 | 6000<br>5200 | — | 2500<br>4200 | 6.5<br>10.8 | |
| | | | | | | | | P.P. Class $A_1$ [6] | 270 | 125* | 270 | 11/17 | 134/145 | — | — | — | 5000 [9] | 18.5 | |
| | | | | | | | | P.P. Class $A_1$ [6] | 250<br>270 | −16.0<br>−17.5 | 250<br>270 | 10/16<br>11/17 | 120/140<br>134/155 | 24500<br>23500 | 5500<br>5700 | — | 5000 [8]<br>5000 [8] | 14.5<br>17.5 | |
| | | | | | | | | P.P. Class $AB_1$ [5] | 360 | 250* | 270 | 5/17 | 88/100 | Power output for 2 tubes. Load plate-to-plate | | | 9000 [9] | 24.5 | |
| | | | | | | | | P.P. Class $AB_1$ [6] | 360 | −22.5 | 270 | 5/15 | 88/132 | | | | 6600 [4] | 26.5 | |
| | | | | | | | | P.P. Class $AB_2$ [6] | 360<br>360 | −18.0<br>−22.5 | 225<br>270 | 3.5/11<br>5/16 | 78/142<br>88/205 | | | | 6000 [9]<br>3800 [9] | 31.0<br>47.0 | |
| 6L7 | Pentagrid Mixer Amplifier | 7T | 6.3 | 0.3 | — | — | — | R.F. Amp. | 250 | — 3.0 | 100 | 5.5 | 5.3 | 800000 | 1100 | — | — | — | 6L7 |
| | | | | | | | | Mixer | 250 | — 6.0 | 150 | 8.3 | 3.3 | Over 1 meg. | Oscillator-grid (No. 3) voltage = −15 | | | | |
| 6N7 | Twin Triode | 8B | 6.3 | 0.8 | — | — | — | Class-B Amp. | 300 | 0 | — | — | 35/70 | — | — | — | 8000 | 10.0 | 6N7 |
| 6Q7 | Duplex-Diode Triode | 7V | 6.3 | 0.3 | 5 | 3.8 | 1.4 | Triode Amp. | 250 | — 3.0 | — | — | 1.1 | 58000 | 1200 | 70 | — | — | 6Q7 |
| 6R7 | Duplex-Diode Triode | 7V | 6.3 | 0.3 | 4.8 | 3.8 | 2.4 | Triode Amp. | 250 | — 9.0 | — | — | 9.5 | 8500 | 1900 | 16 | 10000 | 0.28 | 6R7 |
| 6S7 | Remote Cut-off Pentode | 7R | 6.3 | 0.15 | 6.5 | 10.5 | 0.005 | Class-A Amp. | 250 | — 3.0 | 100 | 2.0 | 8.5 | 1000000 | 1750 | — | — | — | 6S7 |
| 6SA7 | Pentagrid Converter | 8R [2] | 6.3 | 0.3 | — | — | — | Converter | 250 | 0 [3] | 100 | 8.0 | 3.4 | 800000 | Grid No. 1 resistor 20000 ohms | | | | 6SA7 |
| 6SB7Y | Pentagrid Converter | 8R | 6.3 | 0.3 | 9.6 | 9.2 | — | Converter | 100 | — 1 | 100 | 10.2 | 3.6 | 500000 | 900 | — | — | — | 6SB7Y |
| | | | | | | | | Converter | 250 | — 1 | 100 | 10 | 3.8 | 1000000 | 950 | — | — | — | |
| | | | | | Osc. Section in 88–108 Mc. Serv. | | | | 250 | 22000 [9] | 12000 [9] | 12.6/12.5 | 6.8/5.5 | — | — | — | — | — | |
| 6SC7 | Twin-Triode | 8S | 6.3 | 0.3 | — | — | — | Class-A Amp. | 250 | — 2.0 | — | — | 2.0 | 53000 | 1325 | 70 | — | — | 6SC7 |
| 6SF5 | High-μ Triode | 6AB | 6.3 | 0.3 | 4 | 3.6 | 2.4 | Class-A Amp. | 250 | — 2.0 | — | — | 0.9 | 66000 | 1500 | 100 | — | — | 6SF5 |





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## TABLE I—METAL RECEIVING TUBES—*Continued*

| Type | Name | Socket Connections | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6SF7 | Diode Variable-μ Pentode | 7AZ | 6.3 | 0.3 | 5.5 | 6 | 0.004 | Class-A Amp. | 250 | — 1.0 | 100 | 3.3 | 12.4 | 700000 | 2050 | — | — | — | 6SF7 |
| 6SG7 | Semivariable-μ Pentode | 8BK | 6.3 | 0.3 | 8.5 | 7 | 0.003 | H.F. Amp. | 250 | — 2.5 | 150 | 3.4 | 9.2 | Over 1 meg. | 4000 | — | — | — | 6SG7, |
| 6SH7 | Sharp Cut-off Pentode | 8BK | 6.3 | 0.3 | 8.5 | 7 | 0.003 | Class-A Amp. | 250 | — 1.0 | 150 | 4.1 | 10.8 | 900000 | 4900 | — | — | — | 6SH7 |
| 6SJ7 [4] | Sharp Cut-off Pentode | 8N | 6.3 | 0.3 | 6 | 7 | 0.005 | Class-A Amp. | 250 | — 3.0 | 100 | 0.8 | 3 | 1500000 | 1650 | 2500 | — | — | 6SJ7 |
| 6SK7 | Variable-μ Pentode | 8N | 6.3 | 0.3 | 6 | 7 | 0.003 | Class-A Amp. | 250 | — 3.0 | 100 | 2.4 | 9.2 | 800000 | 2000 | 1600 | — | — | 6SK7 |
| 6SQ7 | Duplex-Diode Triode | 8Q | 6.3 | 0.3 | 3.2 | 3.0 | 1.6 | Class-A Amp. | 250 | — 2.0 | — | — | 0.8 | 91000 | 1100 | 100 | — | — | 6SQ7 |
| 6SR7 | Duplex-Diode Triode | 8Q | 6.3 | 0.3 | 3.6 | 2.8 | 2.40 | Class-A Amp. | 250 | — 9.0 | — | — | 9.5 | 8500 | 1900 | 16 | — | — | 6SR7 |
| 6SS7 | Variable-μ Pentode | 8N | 6.3 | 0.15 | 5.5 | 7.0 | 0.004 | Class-A Amp. | 250 | — 3.0 | 100 | 2.0 | 9.0 | 1000000 | 1850 | — | — | — | 6SS7 |
| 6ST7 | Duplex-Diode Triode | 8Q | 6.3 | 0.15 | 2.8 | 3 | 1.50 | Class-A Amp. | 250 | — 9.0 | — | — | 9.5 | 8500 | 1900 | 16 | — | — | 6ST7 |
| 6SV7 | Diode R.F. Pentode | 7AZ | 6.3 | 0.3 | 6.5 | 6 | 0.004 | Class-A Amp. | 250 | — 1 | 150 | 2.8 | 7.5 | 800000 | 3400 | — | — | — | 6SV7 |
| 6SZ7 | Duplex-Diode Triode | 8Q | 6.3 | 0.15 | 2.6 | 2.8 | 1.10 | Class-A Amp. | 250 | — 3 | — | — | 1.0 | 58000 | 1200 | 70 | — | — | 6SZ7 |
| 6T7 | Duplex-Diode Triode | 7V | 6.3 | 0.15 | 1.8 | 3.1 | 1.70 | Class-A Amp. | 250 | — 3.0 | — | — | 1.2 | 62000 | 1050 | 65 | — | — | 6T7 |
| 6V6 | Beam Power Amplifier | 7AC | 6.3 | 0.45 | 2.0 | 7.5 | 0.7 | Class-$A_1$ Amp.[5] | 250 | —12.5 | 250 | 4.5/7.0 | 45/47 | 52000 | 4100 | 218 | 5000 | 4.5 | 6V6 |
| | | | | | | | | Class-$AB_1$ Amp.[6] | 250 | —15.0 | 250 | 5/13 | 70/79 | 60000 | 3750 | — | 10000 [8] | 10.0 | |
| | | | | | | | | | 285 | —19.0 | 285 | 4/13.5 | 70/92 | 65000 | 3600 | — | 8000 [8] | 14.0 | |
| 1611 | Pentode Power Amplifier | 7S | 6.3 | 0.7 | — | — | — | Audio Amp. | Characteristics same as 6F6 | | | | | | | | | | 1611 |
| 1612 | Pentagrid Amplifier | 7T | 6.3 | 0.3 | 7.5 | 11 | 0.001 | Class-A Amp. | 250 | — 3.0 | 100 | 6.5 | 5.3 | 600000 | 1100 | 880 | — | — | 1612 |
| 1620 | Sharp Cut-off Pentode | 7R | 6.3 | 0.3 | — | — | — | Class-A Amp. | Characteristics same as 6J7 | | | | | | | | | | 1620 |
| 1621 | Power Amplifier Pentode | 7S | 6.3 | 0.7 | — | — | — | Class-$AB_2$ Amp.[6] | 300 | —30.0 | 300 | 6.5/13 | 38/69 | — | — | — | 4000 [8] | 5.0 | 1621 |
| | | | | | | | | Class-$A_1$ Amp. [1] | 330 | 500* | — | — | 55/59 | — | — | — | 5000 [8] | 2.0 | |
| 1622 | Beam Power Amplifier | 7AC | 6.3 | 0.9 | — | — | — | Class-$A_1$ Amp. | 300 | —20.0 | 250 | 4/10.5 | 86/125 | — | — | — | 4000 | 10.0 | 1622 |
| 1851 | Television Amp. Pentode | 7R | 6.3 | 0.45 | 11.5 | 5.2 | 0.02 | Class-A Amp. | 300 | — 2.0 | 150 | 2.5 | 10 | 750000 | 9000 | 6750 | — | — | 1851 |
| 5693 | Sharp Cut-off Pentode | 8N | 6.3 | 0.3 | 5.3 | 6.2 | 0.005 | Class-A Amp. | 250 | — 3 | 100 | 0.85 | 3.0 | 1000000 | 1650 | — | — | — | 5693 |

* Cathode resistor—ohms.

[1] Screen tied to plate.
[2] For 6SA7GT use base diagram 8AD.
[3] Grid bias—2 volts if separate oscillator excitation is used.
[4] Also Type "6SJ7Y."
[5] Values are for single tube.
[6] Values are for two tubes in push-pull.
[7] Max.-signal value.
[8] Plate-to-plate value.
[9] Osc. grid leak—Scrn res.

## TABLE II—6.3-VOLT GLASS TUBES WITH OCTAL BASES

(For "G" and "GT"-Type Tubes Not Listed Here, See Equivalent Type in Table I; Characteristics and Connections Will Be Identical)

| Type | Name | Socket Connections | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2C22 | Triode | 4AM | 6.3 | 0.3 | 2.2 | 0.7 | 3.60 | Class-A Amp. | 300 | —10.5 | — | — | 11 | 6600 | 3000 | 20 | — | — | 2C22 |
| 6A5G | Triode Power Amplifier | 6T | 6.3 | 1.0 | — | — | — | Class-A Amp.[4] | 250 | —45.0 | — | — | 60 | 800 | | 4.2 | 2500 | 3.75 | |
| | | | | | | | | P.P. Class AB [5] | 325 | —68.0 | — | — | 80 | — | 5250 | — | 3000 [6] | 15.0 | 6A5G |
| | | | | | | | | P.P. Class AB [6] | 325 | 850* | | | 80 | — | | — | 5000 [6] | 10.0 | |
| 6AB6G | Direct-Coupled Amplifier | 7AU | 6.3 | 0.5 | — | — | — | Class-A Amp. | 250 | 0 | Input | | 5.0 | 40000 | 1800 | 72 | 8000 | 3.5 | 6AB6G |
| | | | | | | | | | 250 | 0 | Output | | 34 | | | | | | |
| 6AC5G | High-μ Power-Amplifier Triode | 6Q | 6.3 | 0.4 | — | — | — | P.P. Class B [5] | 250 | 0 | — | — | 5.0 | 36700 | 3400 | 125 | 10000 [6] | 8.0 | 6AC5G |
| | | | | | | | | Dyn.-Coupled | 250 | — | — | — | 32 | | | | 7000 | 3.7 | |
| 6AC6G | Direct-Coupled Amplifier | 7AU | 6.3 | 1.1 | — | — | — | Class-A Amp. | 100 | 0 | Input | | 7.0 | — | 3000 | 54 | 4000 | 3.8 | 6AC6G |
| | | | | | | | | | 100 | 0 | Output | | 45 | | | | | | |
| 6AD5G | High-μ Triode | 6Q | 6.3 | 0.3 | 4.1 | 3.9 | 3.3 | Class-A Amp. | 250 | — 2.0 | — | — | 0.9 | — | 1500 | 100 | — | — | 6AD5G |
| 6AD6G [10] | Electron-Ray Tube | 7AG | 6.3 | 0.15 | — | — | — | Indicator | 100 | 0 for 90°; —23 for 135°; 45 for 0°. Target current 1.5 ma. | | | | | | | | | 6AD6G |
| 6AD7G | Triode-Pentode | 8AY | 6.3 | 0.85 | — | — | — | Triode Amp. | 250 | —25.0 | — | — | 4.0 | 19000 | 325 | 6.0 | — | — | 6AD7G |
| | | | | | | | | Pentode Amp. | 250 | —16.5 | 250 | 6.5 | 34 | 80000 | 2500 | — | 7000 | 3.2 | |
| 6AE5G [10] | Triode Amplifier | 6Q | 6.3 | 0.3 | — | — | — | Class-A Amp. | 95 | —15.0 | — | — | 7.0 | 3500 | 1200 | 4.2 | — | — | 6AE5G |
| 6AE6GT [10] | Twin-Plate Triode with Single Grid | 7AH | 6.3 | 0.15 | Remote cut-off | | | Class-A Amp. | 250 | — 1.5 | — | — | 6.5 | 25000 | 1000 | 25 | — | — | 6AE6GT |
| | | | | | Sharp cut-off | | | Class-A Amp. | 250 | — 1.5 | | | 4.5 | 35000 | 950 | 33 | | | |

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## TABLE II—6.3-VOLT GLASS TUBES WITH OCTAL BASES—*Continued*

| Type | Name | Socket Connections | Fil. or Heater | | Capacitance μμfd. | | | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Volts | Amp. | In | Out | Plate-Grid | | | | | | | | | | | | |
| 6AE7GT[10] | Twin-Input Triode | 7AX | 6.3 | 0.5 | — | — | — | Driver Amplifier | 250 | −13.5 | — | — | 5.0 | 9300 | 1500 | 14 | — | — | 6AE7GT |
| 6AF5G | Triode | 6Q | 6.3 | 0.3 | — | — | — | Class-A Amplifier | 180 | −18.0 | — | — | 7.0 | — | 1500 | 7.4 | — | — | 6AF5G |
| 6AF7G | Twin Electron Ray | 8AG | 6.3 | 0.3 | — | — | — | Indicator Tube | | | | | | | | | | | 6AF7G |
| 6AG6G | Power-Amplifier Pentode | 7S | 6.3 | 1.25 | — | — | — | Class-A Amplifier | 250 | − 6.0 | 250 | 6.0 | 32 | — | 10000 | — | 8500 | 3.75 | 6AG6G |
| 6AH5G | Beam Power Amplifier | 6AP | 6.3 | 0.9 | — | — | — | Class-A Amplifier | 350 | −18 | 250 | — | — | 33000 | 5200 | — | 4200 | 10.8 | 6AH5G |
| 6AH7GT | Twin Triode | 8BE | 6.3 | 0.3 | — | — | — | Converter & Amp. | 250 | − 9.0 | — | — | 12[1] | 6600 | 2400 | 16 | — | — | 6AH7GT |
| 6AL6G | Beam Power Amplifier | 6AM | 6.3 | 0.9 | — | — | — | Class-A Amplifier | 250 | −14.0 | 250 | 5.0 | 72 | 22500 | 6000 | — | 2500 | 6.5 | 6AL6G |
| 6AL7GT | Electron-Ray Tube | 8CH | 6.3 | 0.15 | — | — | — | Indicator | Outer edge of any of the three illuminated areas displaced 1/16 in. min. outward with +5 volts to its electrode. Similar inward disp. with −5 volts. No pattern with −6 volts grid. | | | | | | | | | | 6AL7GT |
| 6AQ7GT | Duplex Diode Triode | 8CK | 6.3 | 0.3 | 2.3 | 1.5 | 2.8 | Class-A Amplifier | 250 | − 2.0 | — | — | 2.3 | 44000 | 1600 | 70 | — | — | 6AQ7GT |
| 6AR6 | Beam Power Amp. | 6BQ | 6.3 | 1.2 | 11 | 7 | 0.55 | Class-A Amplifier | 250 | −22.5 | 250 | 5 | 77 | 21000 | 5400 | 95 | — | — | 6AR6 |
| 6AR7GT | Diode Triode | 8CG | 6.3 | 0.3 | 1.4 | 1 | 2 | Class-A Amplifier | 250 | − 2 | — | — | 1.3 | 66500 | 1050 | 70 | — | — | 6AR7GT |
| 6AS7G | Low-Mu Twin Triode | 8BD | 6.3 | 2.5 | — | — | — | D.C. Amplifier | 135 | 250* | — | — | 125 | 280 | 7500 | 2.1 | — | — | 6AS7G |
| | | | | | | | | Class-A$_1$ Amp. P.P. | 250 | 2500* | — | — | 100/106 | 280 | 225[9] | — | 6000[6] | 13 | |
| 6B4G | Triode Power Amplifier | 5S | 6.3 | 1.0 | — | — | — | Power Amplifier | Characteristics same as Type 6A3—Table IV | | | | | | | — | — | — | 6B4G |
| 6B6G | Duplex-Diode High-μ Triode | 7V | 6.3 | 0.3 | 1.7 | 3.8 | 1.7 | Detector-Amplifier | Characteristics same as Type 75—Table IV | | | | | | | — | — | — | 6B6G |
| 6BQ6GT | Beam Pentode | 6AM | 6.3 | 1.2 | — | — | — | Deflection Amp. | 250 | 47* | 150 | 2.1 | 45 | | 5500 | — | — | — | 6BQ6GT |
| 6BG6 | Beam Power Amplifier | 5BT | 6.3 | 0.9 | 11 | 6.5 | 0.5 | Deflection Amp. | 400 | −50 | 350 | 6.0 | 70 | — | 6000 | — | — | — | 6BG6 |
| 6C8G | Twin Triode | 8G | 6.3 | 0.3 | — | — | — | Amp. 1 Section | 250 | − 4.5 | — | — | 3.1 | 26000 | 1450 | 38 | — | — | 6C8G |
| 6D8G | Pentagrid Converter | 8A | 6.3 | 0.15 | — | — | — | Converter | 250 | − 3.0 | 100 | Cathode current 13.0 Ma. | | | Anode grid (No. 2) Volts = 250[3] | | | | 6D8G |
| 6E8G[10] | Triode-Hexode Converter | 8O | 6.3 | 0.3 | — | — | — | Converter | 250 | − 2.0 | | | Triode Plate 150 volts | | | | | | 6E8G |
| 6F8G | Twin Triode | 8G | 6.3 | 0.6 | — | — | — | Amplifier | 250 | − 8.0 | — | — | 9[1] | 7700 | 2600 | 20 | — | — | 6F8G |
| 6G6G | Pentode Power Amplifier | 7S | 6.3 | 0.15 | — | — | — | Class-A Amplifier | 180 | − 9.0 | 180 | 2.5 | 15 | 175000 | 2300 | 400 | 10000 | 1.1 | 6G6G |
| | | | | | | | | Class-A Amplifier[2] | 180 | −12.0 | — | — | — | 4750 | 2000 | 9.5 | 12000 | 0.25 | |
| 6H4GT | Diode Rectifier | 5AF | 6.3 | 0.15 | — | — | — | Detector | 100 | — | — | — | 4.0 | — | — | — | — | — | 6H4GT |
| 6H8G | Duo-Diode High-μ Pentode | 8E | 6.3 | 0.3 | — | — | — | Class-A Amplifier | 250 | − 2.0 | 100 | — | 8.5 | 650000 | 2400 | — | — | — | 6H8G |
| 6J8G[10] | Triode Heptode | 8H | 6.3 | 0.3 | — | — | — | Converter | 250 | − 3.0 | 100 | 2.8 | 1.2 | Anode-grid (No. 2) 250 volts max.[3] 5 ma. | | | | | 6J8G |
| 6K5GT[10] | High-μ Triode | 5U | 6.3 | 0.3 | 2.4 | 3.6 | 2.0 | Class-A Amplifier | 250 | − 3.0 | — | — | 1.1 | 50000 | 1400 | 70 | — | — | 6K5GT |
| 6K6GT | Pentode Power Amplifier | 7S | 6.3 | 0.4 | — | — | — | Class-A Amplifier | Characteristics same as Type 41—Table IV | | | | | | | | | | 6K6GT |
| 6L5G | Triode Amplifier | 6Q | 6.3 | 0.15 | 2.8 | 5.0 | 2.8 | Class-A Amplifier | 250 | − 9.0 | — | — | 8.0 | — | 1900 | 17 | — | — | 6L5G |
| 6M6G | Power Amplifier Pentode | 7S | 6.3 | 1.2 | — | — | — | Class-A Amplifier | 250 | − 6.0 | 250 | 4.0 | 36 | — | 9500 | — | 7000 | 4.4 | 6M6G |
| 6M7G | Pentode Amplifier | 7R | 6.3 | 0.3 | — | — | — | R.F. Amplifier | 250 | − 2.5 | 125 | 2.8 | 10.5 | 900000 | 3400 | — | — | — | 6M7G |
| 6M8GT | Diode Triode Pentode | 8AU | 6.3 | 0.6 | — | — | — | Triode Amplifier | 100 | — | — | — | 0.5 | 91000 | 1100 | — | — | — | 6M8GT |
| | | | | | | | | Pentode Amplifier | 100 | − 3.0 | 100 | — | 8.5 | 200000 | 1900 | — | — | — | |
| 6N6G[10] | Direct-Coupled Amplifier | 7AU | 6.3 | 0.8 | — | — | — | Power Amplifier | Characteristics same as Type 6B5—Table IV | | | | | | | — | — | — | 6N6G |
| 6P5GT[10] | Triode Amplifier | 6Q | 6.3 | 0.3 | 3.4 | 5.5 | 2.6 | Class-A Amplifier | 250 | −13.5 | — | — | 5.0 | 9500 | 1450 | 13.8 | — | — | 6P5GT |
| 6P7G[10] | Triode-Pentode | 7U | 6.3 | 0.3 | — | — | — | Class-A Amplifier | Characteristics same as 6F7—Table IV | | | | | | | | | | 6P7G |
| 6P8G | Triode-Hexode Converter | 8K | 6.3 | 0.8 | — | — | — | Converter | 250 | − 2.0 | 75 | 1.4 | 1.5 | Triode Plate 100 v. 2.2 ma. | | | | | 6P8G |
| 6Q6G | Diode-Triode | 6Y | 6.3 | 0.15 | — | — | — | Class-A Amplifier | 250 | − 3.0 | — | — | 1.2 | — | 1050 | 65 | — | — | 6Q6G |
| 6R6G | Pentode Amplifier | 6AW | 6.3 | 0.3 | 4.5 | 11 | 0.007 | Class-A Amplifier | 250 | − 3.0 | 100 | 1.7 | 7.0 | — | 1450 | 1160 | — | — | 6R6G |
| 6S6GT | Remote Cut-off Pentode | 5AK | 6.3 | 0.45 | — | — | — | R.F. Amplifier | 250 | − 2.0 | 100 | 3.0 | 13 | 350000 | 4000 | — | — | — | 6S6GT |
| 6S8GT | Triple Diode Triode | 8CB | 6.3 | 0.3 | 1.2 | 5 | 2 | Class-A Amplifier | 250 | − 2.0 | — | — | 0.9 | 91000 | 1100 | 100 | — | — | 6S8GT |
| 6SD7GT | Medium Cut-off Pentode | 8M | 6.3 | 0.3 | 9 | 7.5 | .0035 | R.F. Amplifier | 250 | − 2.0 | 100 | 1.9 | 6.0 | 1000000 | 3600 | — | — | — | 6SD7GT |
| 6SE7GT | Sharp Cut-off Pentode | 8N | 6.3 | 0.3 | 8 | 7.5 | .005 | R.F. Amplifier | 250 | − 1.5 | 100 | 1.5 | 4.5 | 1100000 | 3400 | 3750 | — | — | 6SE7GT |
| 6SH7L | Pentode R.F. Amp. | 8BK | 6.3 | 0.3 | — | — | — | Class-A Amplifier | 100 | − 1.0 | 100 | 2.1 | 5.3 | 350000 | 4000 | — | — | — | 6SH7L |
| | | | | | | | | | 250 | − 1.0 | 150 | 4.1 | 10.8 | 900000 | 4900 | — | — | — | |
| 6SL7GT | Twin Triode | 8BD | 6.3 | 0.3 | — | — | — | Class-A Amplifier | 250 | − 2.0 | — | — | 2.3[1] | 44000 | 1600 | 70 | — | — | 6SL7GT |
| 6SN7GT | Twin Triode | 8BD | 6.3 | 0.6 | — | — | — | Class-A Amplifier | 250 | − 8.0 | — | — | 9.0[1] | 7700 | 2600 | 20 | — | — | 6SN7GT |

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## TABLE II—6.3-VOLT GLASS TUBES WITH OCTAL BASES—*Continued*

| Type | Name | Socket Connections | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6SU7GTY | Twin Triode | 8BD | 6.3 | 0.3 | — | — | — | Class-A Amplifier | 250 | — 2.0 | — | — | 2.3 | 44000 | 1600 | 70 | — | — | 6SU7GTY |
| 6T6GM [10] | Amplifier | 6Z | 6.3 | 0.45 | — | — | — | Class-A Amplifier | 250 | — 1.0 | 100 | 2.0 | 10 | 1000000 | 5500 | — | — | — | 6T6GM |
| 6U6GT | Beam Power Amplifier | 7AC | 6.3 | 0.75 | — | — | — | Class-A Amplifier | 200 | —14.0 | 135 | 3.0 | 56 | 20000 | 6200 | — | 3000 | 5.5 | 6U6GT |
| 6U7G | Variable-μ Pentode | 7R | 6.3 | 0.3 | 5 | 9 | .007 | Class-A Amplifier | Characteristics same as Type 6D6—Table III | | | | | | | | | | 6U7G |
| 6V7G [10] | Duplex Diode-Triode | 7V | 6.3 | 0.3 | 2 | 3.5 | 1.7 | Detector-Amplifier | Characteristics same as Type 85—Table III | | | | | | | | | | 6V7G |
| 6W6GT | Beam Power Amplifier | 7AC | 6.3 | 1.25 | — | — | — | Class-A Amplifier | 135 | — 9.5 | 135 | 12.0 | 61.0 | — | 9000 | 215 | 2000 | 3.3 | 6W6GT |
| 6W7G | Pentode Det. Amplifier | 7R | 6.3 | 0.15 | 5 | 8.5 | .007 | Class-A Amplifier | 250 | — 3.0 | 100 | 2.0 | 0.5 | 1500000 | 1225 | 1850 | — | — | 6W7G |
| 6X6G | Electron-Ray Tube | 7AL | 6.3 | 0.3 | — | — | — | Indicator Tube | 250 | 0 v. for 300°, 2 ma. —8 v. for 0°, 0 ma. Vane grid 125 v. | | | | | | | | | 6X6G |
| 6Y6G | Beam Power Amplifier | 7AC | 6.3 | 1.25 | 15 | 8 | 0.7 | Class-A Amplifier | 135 | —13.5 | 135 | 3.0 | 60.0 | 9300 | 7000 | — | 2000 | 3.6 | 6Y6G |
| 6Y7G [10] | Twin Triode Amplifier | 8B | 6.3 | 0.3 | — | — | — | Class-B Amplifier | Characteristics same as Type 79—Table IV | | | | | | | | | | 6Y7G |
| 6Z7G | Twin Triode Amplifier | 8B | 6.3 | 0.3 | — | — | — | Class-B Amplifier | 180 | 0 | — | — | 8.4 | — | — | — | 12000 | 4.2 | 6Z7G |
| | | | | | | | | | 135 | 0 | — | — | 6.0 | — | — | — | 9000 | 2.5 | |
| 717A | Sharp Cut-off Pentode | 8BK | 6.3 | 0.175 | — | — | — | Class-A Amplifier | 120 | — 2.0 | 120 | 2.5 | 7.5 | 390000 | 4000 | — | — | — | 717A |
| 1223 | Sharp Cut-off Pentode | 7R | 6.3 | 0.3 | — | — | — | Class-A Amplifier | Characteristics same as 6C6—Table IV | | | | | | | | | | 1223 |
| 1635 | Twin Triode Amplifier | 8B | 6.3 | 0.6 | — | — | — | Class-B Amplifier | 400 | 0 | — | — | 10/63 | — | — | — | 14000 | 17 | 1635 |
| 5691 | Hi-Mu Twin Triode | 8BD | 6.3 | 0.6 | 2.4 [7] 2.7 [8] | 2.3 [7] 2.7 [8] | 3.6 [7] 3.6 [8] | Class-A Amp. | 250 | — 2 | — | — | 2.3 [1] | 44000 | 1600 | 70 | — | — | 5691 |
| 5692 | Medium-Mu Twin Triode | 8BD | 6.3 | 0.6 | 2.3 [7] 2.6 [8] | 2.5 [7] 2.7 [8] | 3.5 [7] 3.3 [8] | Class-A Amp. | 250 | — 9 | — | — | 6.5 [1] | 9100 | 2200 | 18 | — | — | 5692 |
| 7000 | Low-Noise Amplifier | 7R | 6.3 | 0.3 | — | — | — | Class-A Amplifier | Characteristics same as Type 6J7—Table | | | | | | | | | | 7000 |

* Cathode resistor-ohms.

[1] Per plate.
[2] Screen tied to plate.
[3] Through 20,000-ohm dropping resistor.
[4] Values are for single tube.
[5] Values are for two tubes in push-pull.
[6] Plate-to-plate value.
[7] No. 1 triode.
[8] No. 2 triode.
[9] Peak a.f. volts G-G.
[10] Discontinued.

## TABLE III—7-VOLT LOCK-IN-BASE TUBES

**For other lock-in-base types see Tables VIII, IX, and X**

| Type | Name | Socket Connections | Heater Volts | Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7A4 | Triode Amplifier | 5AC | 7.0 | 0.32 | 3.4 | 3 | 4 | Class-A Amplifier | 250 | — 8.0 | — | — | 9.0 | 7700 | 2600 | 20 | — | — | 7A4 |
| 7A5 | Beam Power Amplifier | 6AA | 7.0 | 0.75 | 13 | 7.2 | 0.44 | Class-$A_1$ Amplifier | 125 | — 9.0 | 125 | 3.2/8 | 37.5/40 | 17000 | 6100 | — | 2700 | 1.9 | 7A5 |
| 7A6 | Twin Diode | 7AJ | 7.0 | 0.16 | — | — | — | Rectifier | Max. A.C. volts per plate—150. Max. Output current—10 ma. | | | | | | | | | | 7A6 |
| 7A7 | Remote Cut-off Pentode | 8V | 7.0 | 0.32 | 6 | 7 | .005 | Class-A Amplifier | 250 | — 3.0 | 100 | 2.0 | 8.6 | 800000 | 2000 | 1600 | — | — | 7A7 |
| 7A8 | Multigrid Converter | 8U | 7.0 | 0.16 | 7.5 | 9.0 | 0.15 | Converter | 250 | — 3.0 | 100 | 3.1 | 3.0 | 50000 | Anode-grid 250 volts max. [1] | | | | 7A8 |
| 7AD7 | Pentode | 8V | 6.3 | 0.6 | 11.5 | 7.5 | 0.03 | Class-$A_1$ Amp. | 300 | 68* | 150 | 7.0 | 28.0 | 300000 | 9500 | — | — | — | 7AD7 |
| 7AF7 | Twin Triode | 8AC | 6.3 | 0.3 | 2.2 | 1.6 | 2.3 | Class-A Amp. | 250 | —10 | — | — | 9.0 | 7600 | 2100 | 16 | — | — | 7AF7 |
| 7AG7 | Sharp Cut-off Pentode | 8V | 7.0 | 0.16 | 7.0 | 6.0 | 0.005 | Class-$A_1$ Amp. | 250 | 250* | 250 | 2.0 | 6.0 | 750000 | 4200 | — | — | — | 7AG7 |
| 7AH7 | Pentode Amplifier | 8V | 6.3 | 0.15 | 7.0 | 6.5 | 0.005 | Class-$A_1$ Amplifier | 250 | 250* | 250 | 1.9 | 6.8 | 1000000 | 3300 | — | — | — | 7AH7 |
| 7B4 | High-μ Triode | 5AC | 7.0 | 0.32 | 3.6 | 3.4 | 1.6 | Class-A Amplifier | 250 | — 2.0 | — | — | 0.9 | 66000 | 1500 | 100 | — | — | 7B4 |
| 7B5 | Pentode Power Amplifier | 6AC | 7.0 | 0.43 | 3.2 | 3.2 | 1.6 | Class-$A_1$ Amplifier | 250 | —18.0 | 250 | 5.5/10 | 32/33 | 68000 | 2300 | — | 7600 | 3.4 | 7B5 |
| 7B6 | Duo-Diode Triode | 8W | 7.0 | 0.32 | 3.0 | 2.4 | 1.6 | Class-A Amplifier | 250 | — 2.0 | — | — | 1.0 | 91000 | 1100 | 100 | — | — | 7B6 |
| 7B7 | Remote Cut-off Pentode | 8V | 7.0 | 0.16 | 5 | 7 | .005 | Class-A Amplifier | 250 | — 3.0 | 100 | 2.0 | 8.5 | 700000 | 1700 | 1200 | — | — | 7B7 |
| 7B8 | Pentagrid Converter | 8X | 7.0 | 0.32 | 10.0 | 9.0 | 0.2 | Converter | 250 | — 3.0 | 100 | 2.7 | 3.5 | 360000 | Anode-grid 250 volts max. [1] | | | | 7B8 |
| 7C5 | Tetrode Power Amplifier | 6AA | 7.0 | 0.48 | 9.5 | 9.0 | 0.4 | Class-$A_1$ Amplifier | 250 | —12.5 | 250 | 4.5/7 | 45/47 | 52000 | 4100 | — | 5000 | 4.5 | 7C5 |
| 7C6 | Duo-Diode Triode | 8W | 7.0 | 0.16 | 2.4 | 3 | 1.4 | Class-A Amplifier | 250 | — 1.0 | — | — | 1.3 | 100000 | 1000 | 100 | — | — | 7C6 |
| 7C7 | Pentode Amplifier | 8V | 7.0 | 0.16 | 5.5 | 6.5 | .007 | Class-A Amplifier | 250 | — 3.0 | 100 | 0.5 | 2.0 | 2 meg. | 1300 | — | — | — | 7C7 |
| 7D7 | Triode-Hexode Converter | 8AR | 7.0 | 0.48 | — | — | — | Converter | 250 | — 3.0 | Triode Plate (No. 3) 150 v. 3.5 ma. | | | | | | | | 7D7 |

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## TABLE III—7-VOLT LOCK-IN-BASE TUBES—*Continued*

| Type | Name | Socket Connections | Heater Volts | Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7E6 | Duo-Diode Triode | 8W | 7.0 | 0.32 | — | — | — | Class-A Amplifier | 250 | — 9.0 | — | — | 9.5 | 8500 | 1900 | 16 | — | — | 7E6 |
| 7E7 | Duo-Diode Pentode | 8AE | 7.0 | 0.32 | 4.6 | 4.6 | .005 | Class-A Amplifier | 250 | — 3.0 | 100 | 1.6 | 7.5 | 700000 | 1300 | — | — | — | 7E7 |
| 7F7 | Twin Triode | 8AC | 7.0 | 0.32 | — | — | — | Class-A Amplifier[2] | 250 | — 2.0 | — | — | 2.3 | 44000 | 1600 | 70 | — | — | 7F7 |
| 7F8 | Twin Triode | 8BW | 6.3 | 0.30 | 2.8 | 1.4 | 1.2 | R.F. Amplifier | 250 | — 2.5 | — | — | 10.0 | 10400 | 5000 | — | — | — | 7F8 |
| | | | | | | | | | 180 | — 1.0 | | | 12.0 | 8500 | 7000 | | | | |
| 7G7/1232 | Sharp Cut-off Pentode | 8V | 7.0 | 0.48 | 9 | 7 | .007 | Class-A Amplifier | 250 | — 2.0 | 100 | 2.0 | 6.0 | 800000 | 4500 | — | — | — | 7G7/1232 |
| 7G8/1206 | Dual Tetrode | 8BV | 6.3 | 0.30 | 3.4 | 2.6 | 0.15 | R.F. Amplifier[2] | 250 | — 2.5 | 100 | 0.8 | 4.5 | 225000 | 2100 | — | — | — | 7G8/1206 |
| 7H7 | Semi-Variable-μ Pentode | 8V | 7.0 | 0.32 | 8 | 7 | .007 | R.F. Amplifier | 250 | — 2.5 | 150 | 2.5 | 9.0 | 1000000 | 3500 | — | — | — | 7H7 |
| 7J7 | Triode-Heptode Converter | 8AR | 7.0 | 0.32 | — | — | — | Converter | 250 | — 3.0 | 100 | 2.9 | 1.3 | Triode Plate 250 v. Max.[1] | | | | | 7J7 |
| 7K7 | Duo-Diode High-μ Triode | 8BF | 7.0 | 0.32 | — | — | — | Class-A Amplifier | 250 | — 2.0 | — | — | 2.3 | 44000 | 1600 | 70 | — | — | 7K7 |
| 7L7 | Sharp Cut-off Pentode | 8V | 7.0 | 0.32 | 8 | 6.5 | .01 | Class-A Amplifier | 250 | — 1.5 | 100 | 1.5 | 4.5 | 100000 | 3100 | Cathode Resistor 250 ohms | | | 7L7 |
| 7N7 | Twin Triode | 8AC | 7.0 | 0.6 | 3.4[4] 2.9[4] | 2.0[3] 2.4[4] | 3.0[3] 3.0[4] | Class-A Amplifier[2] | 250 | — 8.0 | — | — | 9.0 | 7700 | 2600 | 20 | — | — | 7N7 |
| 7Q7 | Pentagrid Converter | 8AL | 7.0 | 0.32 | — | — | — | Converter | 250 | 0 | 100 | 8.0 | 3.4 | 800000 | Grid No. 1 resistor 20000 ohms | | | | 7Q7 |
| 7R7 | Duo-Diode Pentode | 8AE | 7.0 | 0.32 | 5.6 | 5.3 | .004 | Class-A Amplifier | 250 | — 1.0 | 100 | 1.7 | 5.7 | 1000000 | 3200 | — | — | — | 7R7 |
| 7S7 | Triode Hexode Converter | 8BL | 7.0 | 0.32 | — | — | — | Converter | 250 | — 2.0 | 100 | 2.2 | 1.7 | 2000000 | Triode Plate 250 v. Max.[1] | | | | 7S7 |
| 7T7 | Pentode Amplifier | 8V | 7.0 | 0.32 | 8 | 7 | .005 | Class-A Amplifier | 250 | — 1.0 | 150 | 4.1 | 10.8 | 900000 | 4900 | — | — | — | 7T7 |
| 7V7 | Sharp Cut-off Pentode | 8V | 7.0 | 0.48 | 9.5 | 6.5 | .004 | Class-A Amplifier | 300 | 160* | 150 | 3.9 | 10 | 300000 | 5800 | — | — | — | 7V7 |
| 7W7 | Sharp Cut-off Pentode | 8BJ | 7.0 | 0.48 | 9.5 | 7.0 | .0025 | Class-A Amplifier | 300 | — 2.2 | 150 | 3.9 | 10 | 300000 | 5800 | — | — | — | 7W7 |
| 7X7 | Duo-Diode Triode | 8BZ | 6.3 | 0.3 | — | — | — | Class-A Amplifier | 250 | — 1.0 | — | — | 1.9 | 67000 | 1500 | 100 | — | — | 7X7 |
| 1231 | Pentode Amplifier | 8V | 6.3 | 0.45 | 8.5 | 6.5 | .015 | Class-A Amplifier | 300 | 200* | 150 | 2.5 | 10 | 700000 | 5500 | 3850 | — | — | 1231 |
| 1273 | Nonmicrophonic Pentode | 8V | 7.0 | 0.32 | 6.0 | 6.5 | .007 | Class-$A_1$ Amplifier | 250 | — 3.0 | 100 | 0.7 | 2.2 | 1000000 | 1575 | — | — | — | 1273 |
| | | | | | | | | | 100 | — 1.0 | 100 | 1.8 | 5.7 | 400000 | 2275 | — | — | — | |
| 5679 | Twin Diode | 7CX | 6.3 | 0.15 | — | — | — | V.T.V.M. Rectifier | Same as 7A6 | | | | | | | | | | 5679 |
| XXL | Triode Oscillator | 5AC | 7.0 | 0.32 | — | — | — | Oscillator | 250 | — 8.0 | — | — | 8.0 | — | 2300 | 20 | — | — | XXL |

* Cathode resistor—ohms. [1] Applied through 20000-ohm dropping resistor. Each section. [3] Triode No. 1. [4] Triode No. 2.

## TABLE IV—6.3-VOLT GLASS RECEIVING TUBES

| Type | Name | Base | Socket Connections | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2C21/1642 | Twin-Triode Amplifier | M. | 7BH | 6.3 | 0.6 | — | — | — | Class-A Amp. | 250 | —16.5 | — | — | 8.3 | 7600 | 1375 | 10.4 | — | — | 2C21/1642 |
| 6A3 | Triode Power Amplifier | M. | 4D | 6.3 | 1.0 | 7.0 | 5.0 | 16.0 | Class-A Amp. | 250 | —45 | — | — | 60 | 800 | 5250 | 4.2 | 2500 | 3.5 | 6A3 |
| | | | | | | | | | Class $AB_1$ Amp.[10] | 300 | —62 | Fixed Bias | | 80 | — — | — | — | 3000[11] | 15 | |
| | | | | | | | | | | 300 | 850* | Self Bias | | 80 | | | | 5000[11] | 10 | |
| 6A4# | Pentode Power Amplifier | M. | 5B | 6.3 | 0.3 | — | — | — | Class-A Amp. | 180 | —12.0 | 180 | 3.9 | 22 | 60000 | 2500 | 150 | 8000 | 1.5 | 6A4 |
| 6A6 | Twin Triode Amplifier | M. | 7B | 6.3 | 0.8 | — | — | — | Class-B Amp. P.P. | 250 | 0 | — | — | Power output is for one tube at stated load, plate-to-plate | | | | 8000 | 8.0 | 6A6 |
| | | | | | | | | | | 300 | 0 | | | | | | | 10000 | 10.0 | |
| 6A7 | Pentagrid Converter | S. | 7C | 6.3 | 0.3 | 8.5 | 9.0 | 0.3 | Converter | 250 | — 3.0 | 100 | 2.2 | 3.5 | 360000 | Anode grid (No. 2) 200 volts max. | | | | 6A7 |
| 6AB5/6N5 | Electron-Ray Tube | S. | 6R | 6.3 | 0.15 | — | — | — | Indicator Tube | 180 | Cut-off Grid Bias = —12 v. | | | 0.5 | Target Current 2 ma. | | | — | | 6AB5/6N5 |
| 6AF6G | Electron-Ray Tube Twin Indicator Type | S. | 7AG | 6.3 | 0.15 | — | — | — | Indicator Tube | 135 | Ray Control Voltage = 81 for 0° Shadow Angle. Target current 1.5 ma. | | | | | | | | | 6AF6G |
| | | | | | | | | | | 100 | Ray Control Voltage = 60 for 0° Shadow Angle. Target current 0.9 ma. | | | | | | | | | |
| 6B5 | Direct-Coupled Power Amplifier | M. | 6AS | 6.3 | 0.8 | — | — | — | Class-A Amp.[9] | 300 | 0 | — | 6[1] | 45 | 241000 | 2400 | 58 | 7000 | 4.0 | 6B5 |
| | | | | | | | | | Push-Pull Amp.[10] | 400 | —13.0 | — | 4.5[1] | 40 | — | — | — | 10000[11] | 20 | |

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## TABLE IV—6.3-VOLT GLASS RECEIVING TUBES—*Continued*

| Type | Name | Base | Socket Connections | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6B7 | Duplex-Diode Pentode | S. | 7D | 6.3 | 0.3 | 3.5 | 9.5 | .007 | Pentode R.F. Amp. | 250 | — 3.0 | 125 | 2.3 | 9.0 | 650000 | 1125 | 730 | — | — | 6B7 |
| 6C6 | Sharp Cut-off Pentode | S. | 6F | 6.3 | 0.3 | 5 | 6.5 | .007 | R.F. Amplifier | 250 | — 3.0 | 100 | 0.5 | 2.0 | 1500000 | 1225 | 1500 | — | — | 6C6 |
| 6C7 | Duplex Diode Triode | S. | 7G | 6.3 | 0.3 | — | — | — | Class-A Amp. | 250 | — 9.0 | — | — | 4.5 | — | 20 | 1250 | — | — | 6C7 |
| 6D6 | Variable-μ Pentode | S. | 6F | 6.3 | 0.3 | 4.7 | 6.5 | .007 | R.F. Amplifier | 250 | — 3.0 | 100 | 2.0 | 8.2 | 800000 | 1600 | 1280 | — | — | 6D6 |
| 6D7 # | Sharp Cut-off Pentode | S. | 7H | 6.3 | 0.3 | 5.2 | 6.8 | .01 | Class-A Amp. | 250 | — 3.0 | 100 | 0.5 | 2.0 | — | 1600 | 1280 | — | — | 6D7 |
| 6E5 | Electron-Ray Tube | S. | 6R | 6.3 | 0.3 | — | — | — | Indicator Tube | 250 | 0 | — | — | 0.25 | Target Current 4 ma. | | | | — | 6E5 |
| 6E6 | Twin Triode Amplifier | M. | 7B | 6.3 | 0.6 | — | — | — | Class-A Amp. | 250 | —27.5 | Per plate—18.0 | | | 3500 | 1700 | 6.0 | 14000 | 1.6 | 6E6 |
| 6E7 | Variable-μ Pentode | S. | 7H | 6.3 | 0.3 | — | — | — | R.F. Amplifier | Characteristics same as 6U7G—Table II | | | | | | | | | | 6E7 |
| 6F7 | Triode Pentode | S. | 7E | 6.3 | 0.3 | — | — | — | Triode Unit Amp. | 100 | — 3.0 | — | — | 3.5 | 16000 | 500 | 8 | — | — | 6F7 |
| | | | | | | | | | Pentode Unit Amplifier | 250 | — 3.0 | 100 | 1.5 | 6.5 | 850000 | 1100 | 900 | — | — | |
| 6U5/6G5 | Electron-Ray Tube | S. | 6R | 6.3 | 0.3 | — | — | — | Indicator Tube | 250 | Cut-off Grid Bias = —22 v. | | | 0.24 | Target Current 4 ma. | | | | — | 6U5/6G5 |
| | | | | | | | | | | 100 | Cut-off Grid Bias = —8 v. | | | 0.19 | Target Current 1 ma. | | | | | |
| 6H5 | Electron-Ray Tube | S. | 6R | 6.3 | 0.3 | — | — | — | Indicator Tube | Same characteristics as Type 6G5—Circular Pattern | | | | | | | | | | 6H5 |
| 6T5 | Electron-Ray Tube | S. | 6R | 6.3 | 0.3 | — | — | — | Indicator Tube | 250 | Cut-off Grid Bias —12 v. | | | 0.24 | Target Current 4 ma. | | | | — | 6T5 |
| 36 | Tetrode R.F. Amplifier | S. | 5E | 6.3 | 0.3 | 3.8 | 9 | .007 | R.F. Amplifier | 250 | — 3.0 | 90 | 1.7 | 3.2 | 550000 | 1080 | 595 | — | — | 36 |
| 37 | Triode Detector Amplifier | S. | 5A | 6.3 | 0.3 | 3.5 | 2.9 | 2 | Class-A Amp. | 250 | — 18.0 | — | — | 7.5 | 8400 | 1100 | 9.2 | — | — | 37 |
| 38 | Pentode Power Amplifier | S. | 5F | 6.3 | 0.3 | 3.5 | 7.5 | 0.3 | Class-A Amp. | 250 | —25.0 | 250 | 3.8 | 22.0 | 100000 | 1200 | 120 | 10000 | 2.5 | 38 |
| 39/44 | Remote Cut-off Pentode | S. | 5F | 6.3 | 0.3 | 3.8 | 10 | .007 | R.F. Amplifier | 250 | — 3.0 | 90 | 1.4 | 5.8 | 1000000 | 1050 | 1050 | — | — | 39/44 |
| 41 | Pentode Power Amplifier | S. | 6B | 6.3 | 0.4 | — | — | — | Class-A Amp. | 250 | —18.0 | 250 | 5.5 | 32.0 | 68000 | 2200 | 150 | 7600 | 3.4 | 41 |
| 42 | Pentode Power Amplifier | M. | 6B | 6.3 | 0.7 | — | — | — | Class-A Amp. | 250 | —16.5 | 250 | 6.5 | 34.0 | 100000 | 2200 | 220 | 7000 | 3.0 | 42 |
| 52 | Dual Grid Triode | M. | 5C | 6.3 | 0.3 | — | — | — | Class-A Amp.[4] | 110 | 0 | — | — | 43.0 | 1750 | 3000 | 5.2 | 2000 | 1.5 | 52 |
| | | | | | | | | | Class-B, 2 tubes[5] | 180 | 0 | — | — | 3.0 | | | | 10000 | 5.0 | |
| 56AS | Triode Amplifier | S. | 5A | 6.3 | 0.4 | — | — | — | Class-A Amp. | Characteristics same as 56 | | | | | | | | | | 56AS |
| 57AS | Sharp Cut-off Pentode | S. | 6F | 6.3 | 0.4 | — | — | — | R.F. Amplifier | Characteristics same as 57 | | | | | | | | | | 57AS |
| 58AS | Remote Cut-off Pentode | S. | 6F | 6.3 | 0.4 | — | — | — | R.F. Amplifier | Characteristics same as 58 | | | | | | | | | | 58AS |
| 75 | Duplex-Diode Triode | S. | 6G | 6.3 | 0.3 | 1.7 | 3.8 | 1. | Triode Amplifier | 250 | — 1.35 | — | — | 0.4 | 91000 | 1100 | 100 | — | — | 75 |
| 76 | Triode Detector Amplifier | S. | 5A | 6.3 | 0.3 | 3.5 | 2.5 | 2.8 | Class-A Amp. | 250 | —13.5 | — | — | 5.0 | 9500 | 1450 | 13.8 | — | — | 76 |
| 77 | Sharp Cut-off Pentode | S. | 6F | 6.3 | 0.3 | 4.7 | 11 | .007 | R.F. Amplifier | 250 | — 3.0 | 100 | 0.5 | 2.3 | 1500000 | 1250 | 1500 | — | — | 77 |
| 78 | Variable-μ Pentode | S. | 6F | 6.3 | 0.3 | 4.5 | 11 | .007 | R.F. Amplifier | 250 | — 3.0 | 100 | 1.7 | 7.0 | 800000 | 1450 | 1160 | — | — | 78 |
| 79 | Twin Triode Amplifier | S. | 6H | 6.3 | 0.6 | — | — | — | Class-B Amp. | 250 | 0 | — | — | 10.6[12] | Power output is for one tube | | | 14000 | 8.0 | 79 |
| 85 | Duplex-Diode Triode | S. | 6G | 6.3 | 0.3 | 1.5 | 4.3 | 1.5 | Class-A Amp. | 250 | —20.0 | — | — | 8.0 | 7500 | 1100 | 8.3 | 20000 | 0.35 | 85 |
| 85AS | Duplex-Diode Triode | S. | 6G | 6.3 | 0.3 | — | — | — | Class-A Amp. | 250 | — 9.0 | — | — | 5.5 | — | 1250 | 20 | — | — | 85AS |
| 89 | Power Amplifier Pentode | S. | 6F | 6.3 | 0.4 | — | — | — | Triode Amp.[2] | 250 | —31.0 | — | — | 32.0 | 2600 | 1800 | 4.7 | 5500 | 0.9 | 89 |
| | | | | | | | | | Pentode Amp.[8] | 250 | —25.0 | 250 | 5.5 | 32.0 | 70000 | 1800 | 125 | 6750 | 3.4 | |
| 1221 | Pentode R.F. Amplifier | S. | 6F | 6.3 | 0.3 | — | — | — | Class-A Amp. | Special non-microphonic. Characteristics same as 6C6 | | | | | | | | | | 1221 |
| 1603[3] | Sharp Cut-off Pentode | M. | 6F | 6.3 | 0.3 | — | — | — | Class-A Amp. | Characteristics same as 6C6 | | | | | | | | | | 1603 |
| 7700[3] | Sharp Cut-off Pentode | S. | 6F | 6.3 | 0.3 | — | — | — | Class-A Amp. | Characteristics same as 6C6 | | | | | | | | | | 7700 |

* Cathode bias resistor—ohms.
\# Discontinued.

[1] Current to input plate ($P_1$).
[2] Grids Nos. 2 and 3 connected to plate.
[3] Low noise, nonmicrophonic tubes.
[4] $G_2$ tied to plate.
[5] $G_1$ tied to $G_2$.
[6] Osc. grid leak ohms.
[7] Screen dropping resistor ohms.
[8] Grid No. 2, screen; grid No. 3, suppressor.
[9] Values for single tube.
[10] Values for two tubes in push-pull.
[11] Plate-to-plate value.
[12] No signal value.

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## TABLE V—2.5-VOLT RECEIVING TUBES

| Type | Name | Base | Socket Connections | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2S/4S | Duodiode | M. | 5D | 2.5 | 1.35 | — | — | — | Detector | At 50 d.c. Volts per plate, cathode ma. = 80 | | | | | | | | | | 2S/4S |
| 2A3 | Triode Power Amplifier | M. | 4D | 2.5 | 2.5 | 7.5 | 5.5 | 16.5 | Class-A Amp. | Characteristics same as Type 6A3, Table IV | | | | | | | | | | 2A3 |
| 2A5 | Pentode Power Amplifier | M. | 6B | 2.5 | 1.75 | — | — | — | Class-A Amp. | Characteristics same as Type 42, Table IV | | | | | | | | | | 2A5 |
| 2A6 | Duplex-Diode Triode | S. | 6G | 2.5 | 0.8 | 1.7 | 3.8 | 1.7 | Class-A Amp. | Characteristics same as Type 75, Table IV | | | | | | | | | | 2A6 |
| 2A7 | Pentagrid Converter | S. | 7C | 2.5 | 0.8 | — | — | — | Converter | Characteristics same as Type 6A7, Table IV | | | | | | | | | | 2A7 |
| 2B6 | Direct-Coupled Amplifier | M. | 7J | 2.5 | 2.25 | — | — | — | Amplifier | 250 | −24.0 | — | — | 40.0 | 5150 | 3500 | 18.0 | 5000 | 4.0 | 2B6 |
| 2B7 | Duplex-Diode Pentode | S. | 7D | 2.5 | 0.8 | 3.5 | 9.5 | .007 | Pentode Amp. | Characteristics same as Type 6B7—Table IV | | | | | | | | | | 2B7 |
| 2E5 | Electron-Ray Tube | S. | 6R | 2.5 | 0.8 | — | — | — | Indicator Tube | Characteristics same as Type 6E5—Table IV | | | | | | | | | | 2E5 |
| 2G5 | Electron-Ray Tube | S. | 6R | 2.5 | 0.8 | — | — | — | Indicator Tube | Characteristics same as 6U5/6G5—Table IV | | | | | | | | | | 2G5 |
| 24-A | Tetrode R.F. Amplifier | M. | 5E | 2.5 | 1.75 | 5.3 | 10.5 | .007 | Screen-Grid R.F. Amplifier | 250 | — 3.0 | 90 | 1.7 | 4.0 | 600000 | 1050 | 630 | — | — | 24-A |
| | | | | | | | | | Bias Detector | 250 | — 5.0 | 20/45 | Plate current adjusted to 0.1 ma. with no signal | | | | | | | |
| 27 | Triode Detector-Amplifier | M. | 5A | 2.5 | 1.75 | 3.1 | 2.3 | 3.3 | Class-A Amp. | 250 | −21.0 | — | — | 5.2 | 9250 | 975 | 9.0 | — | — | 27 |
| | | | | | | | | | Bias Detector | 250 | −30.0 | — | Plate current adjusted to 0.2 ma. with no signal | | | | | | | |
| 35/51 | Remote Cut-off Pentode | M. | 5E | 2.5 | 1.75 | 5.3 | 10.5 | .007 | Screen-Grid R.F. Amplifier | 250 | — 3.0 | 90 | 2.5 | 6.5 | 400000 | 1050 | 420 | — | — | 35/51 |
| 45 | Triode Power Amplifier | M. | 4D | 2.5 | 1.5 | 4 | 3 | 7 | Class-A Amp. | 275 | −56.0 | — | — | 36.0 | 1700 | 2050 | 3.5 | 4600 | 2.00 | 45 |
| 46 | Dual-Grid Power Amp. | M. | 5C | 2.5 | 1.75 | — | — | — | Class-A Amp.[2] | 250 | −33.0 | — | — | 22.0 | 2380 | 2350 | 5.6 | 6400 | 1.25 | 46 |
| | | | | | | | | | Class-B Amp.[3] | 400 | 0 | — | — | 12 | Power output for 2 tubes | | | 5800 | 20.0 | |
| 47 | Pentode Power Amplifier | M. | 5B | 2.5 | 1.75 | 8.6 | 13 | 1.2 | Class-A Amp. | 250 | −16.5 | 250 | 6.0 | 31.0 | 60000 | 2500 | 150 | 7000 | 2.7 | 47 |
| 53 | Twin Triode Amplifier | M. | 7B | 2.5 | 2.0 | — | — | — | Class-B Amp. | Characteristics same as Type 6A6, Table IV | | | | | | | | | | 53 |
| 55 | Duplex-Diode Triode | S. | 6G | 2.5 | 1.0 | 1.5 | 4.3 | 1.5 | Class-A Amp. | Characteristics same as Type 85, Table IV | | | | | | | | | | 55 |
| 56 | Triode Amplifier, Detector | S. | 5A | 2.5 | 1.0 | 3.2 | 2.4 | 3.2 | Class-A Amp. | Characteristics same as Type 76, Table IV | | | | | | | | | | 56 |
| 57 | Sharp Cut-off Pentode | S. | 6F | 2.5 | 1.0 | — | — | — | R.F. Amplifier | 250 | — 3.0 | 100 | 0.5 | 2.0 | 1500000 | 1225 | 1500 | — | — | 57 |
| 58 | Remote Cut-off Pentode | S. | 6F | 2.5 | 1.0 | 4.7 | 6.3 | .007 | Screen-Grid R.F. Amplifier | 250 | — 3.0 | 100 | 2.0 | 8.2 | 800000 | 1600 | 1280 | — | — | 58 |
| 59 | Pentode Power Amplifier | M. | 7A | 2.5 | 2.0 | — | — | — | Class-A Triode[4] | 250 | −28.0 | — | — | 26.0 | 2300 | 2600 | 6.0 | 5000 | 1.25 | 59 |
| | | | | | | | | | Class-A Pentode[5] | 250 | −18.0 | 250 | 9.0 | 35.0 | 40000 | 2500 | 100 | 6000 | 3.0 | |
| RK15 | Triode Power Amplifier | M. | 4D[1] | 2.5 | 1.75 | — | — | — | Characteristics same as Type 46 with Class-B connections | | | | | | | | | | | RK15 |
| RK16 | Triode Power Amplifier | M. | 5A | 2.5 | 2.0 | — | — | — | Characteristics same as Type 59 with Class-A triode connections | | | | | | | | | | | RK16 |
| RK17 | Pentode Power Amplifier | M. | 5F | 2.5 | 2.0 | — | — | — | Characteristics same as Type 2A5 | | | | | | | | | | | RK17 |

[1] Grid connection to cap; no connection to No. 3 pin. [2] Grid No. 2 tied to plate. [3] Grids Nos. 1 and 2 tied together. [4] Grids Nos. 2 and 3 connected to plate. [5] Grid No. 2, screen; grid No. 3, suppressor.

## TABLE VI—2.0-VOLT BATTERY RECEIVING TUBES

| Type | Name | Base | Socket Connections | Filament Volts | Filament Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1A4P | Variable-μ Pentode | S. | 4M | 2.0 | 0.06 | 5 | 11 | .007 | R.F. Amplifier | 180 | — 3.0 | 67.5 | 0.8 | 2.3 | 1000000 | 750 | 750 | — | — | 1A4P |
| 1A4T | Variable-μ Tetrode | S. | 4K | 2.0 | 0.06 | 5 | 11 | .007 | R.F. Amplifier | 180 | — 3.0 | 67.5 | 0.7 | 2.3 | 960000 | 750 | 720 | — | — | 1A4T |
| 1A6 | Pentagrid Converter | S. | 6L | 2.0 | 0.06 | — | — | — | Converter | 180 | — 3.0 | 67.5 | 2.4 | 1.3 | 500000 | Anode grid (No. 2) 180 max. volts | | | | 1A6 |
| 1B4P/951 | Pentode R.F. Amplifier | S. | 4M | 2.0 | 0.06 | 5 | 11 | .007 | R.F. Amplifier | 180<br>90 | — 3.0<br>— 3.0 | 67.5<br>67.5 | 0.6<br>0.7 | 1.7<br>1.6 | 1500000<br>1000000 | 650<br>600 | 1000<br>550 | — | — | 1B4P/951 |
| 1B5/25S | Duplex-Diode Triode | S. | 6M | 2.0 | 0.06 | 1.6 | 1.9 | 3.6 | Triode Class-A | 135 | — 3.0 | — | — | 0.8 | 35000 | 575 | 20 | — | — | 1B5/25S |

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## TABLE VI—2.0-VOLT BATTERY RECEIVING TUBES—*Continued*

| Type | Name | Base | Socket Connections | Filament Volts | Filament Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1C6 | Pentagrid Converter | S. | 6L | 2.0 | 0.12 | 10 | 10 | — | Converter | 180 | — 3.0 | 67.5 | 2.0 | 1.5 | 750000 | Anode grid (No. 2) 135 max. volts | | | | 1C6 |
| 1F4 | Pentode Power Amplifier | M. | 5K | 2.0 | 0.12 | — | — | — | Class-A Amp. | 135 | — 4.5 | 135 | 2.6 | 8.0 | 200000 | 1700 | 340 | 16000 | 0.34 | 1F4 |
| 1F6 | Duplex-Diode Pentode | S. | 6W | 2.0 | 0.06 | 4 | 9 | .007 | R.F. Amplifier | 180 | — 1.5 | 67.5 | 0.6 | 2.0 | 1000000 | 650 | 650 | — | — | 1F6 |
| | | | | | | | | | A.F. Amplifier | 135 | — 1.0 | 135 | Plate, 0.25 megohm; screen, 1.0 megohm | | | | | Amp. =48 | | |
| 15 # | Sharp Cut-off Pentode | S. | 5F | 2.0 | 0.22 | 2.3 | 7.8 | 0.01 | R.F. Amplifier | 135 | — 1.5 | 67.5 | 0.3 | 1.85 | 800000 | 750 | 600 | — | — | 15 |
| 19 | Twin-Triode Amplifier | S. | 6C | 2.0 | 0.26 | — | — | — | Class-B Amp. | 135 | 0 | — | — | — | Load plate-to-plate | | | 10000 | 2.1 | 19 |
| 30 | Triode Detector Amplifier | S. | 4D | 2.0 | 0.06 | — | — | — | Class-A Amp. | 180 | —13.5 | — | — | 3.1 | 10300 | 900 | 9.3 | — | — | 30 |
| 31 | Triode Power Amplifier | S. | 4D | 2.0 | 0.13 | 3.5 | 2.7 | 5.7 | Class-A Amp. | 180 | —30.0 | — | — | 12.3 | 3600 | 1050 | 3.8 | 5700 | 0.375 | 31 |
| 32 | Sharp Cut-off Pentode | M. | 4K | 2.0 | 0.06 | 5.3 | 10.5 | .015 | R.F. Amplifier | 180 | — 3.0 | 67.5 | 0.4 | 1.7 | 1200000 | 650 | 780 | — | — | 32 |
| 33 | Pentode Power Amplifier | M. | 5K | 2.0 | 0.26 | 8 | 12 | 1 | Class-A Amp. | 180 | —18.0 | 180 | 5.0 | 22.0 | 55000 | 1700 | 90 | 6000 | 1.4 | 33 |
| 34 | Variable-μ Pentode | M. | 4M | 2.0 | 0.06 | 6 | 11 | .015 | R.F. Amplifier | 180 | — 3.0 | 67.5 | 1.0 | 2.8 | 1000000 | 620 | 620 | — | — | 34 |
| 49 | Dual-Grid Power Amp. | M. | 5C | 2.0 | 0.12 | — | — | — | Class-A Amp.[1] | 135 | —20.0 | — | — | 6.0 | 4175 | 1125 | 4.7 | 11000 | 0.17 | 49 |
| | | | | | | | | | Class-B Amp.[2] | 180 | 0 | — | — | Power output for 2 tubes | | | | 12000 | 3.5 | |
| 840 | Pentode | S. | 5J | 2.0 | 0.13 | — | — | — | Class-A Amp. | 180 | — 3.0 | 67.5 | 0.7 | 1.0 | 1000000 | 400 | 400 | — | — | 840 |
| 950 | Pentode Power Amplifier | M. | 5K | 2.0 | 0.12 | — | — | — | Class-A Amp. | 135 | —16.5 | 135 | 2.0 | 7.0 | 100000 | 1000 | 125 | 13500 | 0.575 | 950 |
| RK24 | Triode | M. | 4D | 2.0 | 0.12 | — | — | — | Class-A Amp. | 180 | —13.5 | — | — | 8.0 | 5000 | 1600 | 8.0 | 12000 | 0.25 | RK24 |
| 1229 | Tetrode | M. | 4K | 2.0 | 0.06 | — | — | — | Special Type 32 for low grid-current applications | | | | | | | | | | | 1229 |
| 1230 | Triode | M. | 4D | 2.0 | 0.06 | 3.0 | 2.1 | 6.0 | Special Type 30 for low grid-current applications | | | | | | | | | | | 1230 |

# Discontinued. [1] Grid No. 2 tied to plate. [2] Grids Nos. 1 and 2 tied together.

## TABLE VII—2.0-VOLT BATTERY TUBES WITH OCTAL BASES

| Type | Name | Socket Connections | Filament Volts | Filament Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1C7G | Heptode | 7Z | 2.0 | 0.06 | 10 | 14 | 0.26 | Converter | Characteristics same as Type 1C6—Table VI | | | | | | | | | | 1C7G |
| 1D5GP | Variable-μ Pentode | 5Y | 2.0 | 0.06 | 5 | 11 | .007 | R.F. Amplifier | Characteristics same as Type 1A4P—Table VI | | | | | | | | | | 1D5GP |
| 1D5GT # | Variable-μ Tetrode | 5R | 2.0 | 0.06 | — | — | — | R.F. Amplifier | 180 | — 3.0 | 67.5 | 0.7 | 2.2 | 600000 | 650 | | | | 1D5GT |
| 1D7G | Pentagrid Converter | 7Z | 2.0 | 0.06 | 10.5 | 9.0 | 0.25 | Converter | Characteristics same as Type 1A6—Table VI | | | | | | | | | | 1D7G |
| 1E5GP | Pentode Amplifier | 5Y | 2.0 | 0.06 | 5 | 11 | .007 | R.F. Amplifier | Characteristics same as Type 1B4—Table VI | | | | | | | | | | 1E5GP |
| 1E7G | Double Pentode Power Amp. | 8C | 2.0 | 0.24 | — | — | — | Class-A Amplifier | 135 | — 7.5 | 135 | 2.0[1] | 6.5[1] | 220000 | 1600 | 350 | 24000 | 0.65 | 1E7G |
| 1F5G | Pentode Power Amplifier | 6X | 2.0 | 0.12 | — | — | — | Class-A Amplifier | Characteristics same as Type 1F4—Table VI | | | | | | | | | | 1F5G |
| 1F7G[2] | Duplex-Diode Pentode | 7AD | 2.0 | 0.06 | 3.8 | 9.5 | 0.01 | Detector-Amplifier | Characteristics same as Type 1F6—Table VI | | | | | | | | | | 1F7G |
| 1G5G | Pentode Power Amplifier | 6X | 2.0 | 0.12 | — | — | — | Class-A Amplifier | 135 | —13.5 | 135 | 2.5 | 8.7 | 160000 | 1550 | 250 | 9000 | 0.55 | 1G5G |
| 1H4G | Triode Amplifier | 5S | 2.0 | 0.06 | — | — | — | Detector-Amplifier | Characteristics same as Type 30—Table VI | | | | | | | | | | 1H4G |
| 1H6G | Duplex-Diode Triode | 7AA | 2.0 | 0.06 | 1.6 | 1.9 | 3.6 | Detector-Amplifier | Characteristics same as Type 1B5—Table VI | | | | | | | | | | 1H6G |
| 1J5G # | Pentode Power Amplifier | 6X | 2.0 | 0.12 | — | — | — | Class-A Amplifier | 135 | —16.5 | 135 | 2.0 | 7.0 | — | 950 | 100 | 13500 | 0.45 | 1J5G |
| 1J6G | Twin Triode | 7AB | 2.0 | 0.24 | — | — | — | Class-B Amplifier | Characteristics same as Type 19—Table VI | | | | | | | | | | 1J6G |
| 4A6G | Twin Triode | 8L | 2.0 | 0.12 | — | — | — | Class-A, 1 section | 90 | — 1.5 | — | — | 1.1 | 26600 | 750 | 20 | | | 4A6G |
| | | | 4.0 | 0.06 | | | | Class-B, 2 sections | 90 | — 1.5 | — | — | 10.8[3] | | | | 8000 | 1.0 | |

# Discontinued. [1] Total current for both sections; no signal. [2] Type GV has 7AF base. [3] Max. signal.

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## TABLE VIII—1.5-VOLT FILAMENT BATTERY TUBES

See also Table X for Special 1.4-volt Tubes

| Type | Name | Base | Socket Connections | Filament Volts | Filament Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output M-watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1A5GT | Pentode Power Amplifier | O. | 6X | 1.4 | 0.05 | — | — | — | Class-$A_1$ Amp. | 90 | −4.5 | 90 | 0.8 | 4.0 | 300000 | 850 | 240 | 25000 | 115 | 1A5GT |
| 1A7GT | Pentagrid Converter | O. | 7Z | 1.4 | 0.05 | — | — | — | Converter | 90 | 0 | 45 | 0.6 | 0.55 | 600000 | Anode-grid volts 90 | | | | 1A7GT |
| 1AB5 | Pentode R.F. Amplifier | L. | 5BF | 1.2 | 0.05 | 2.8 | 4.2 | 0.25 | R.F. Amplifier | 90<br>150 | 0<br>−1.5 | 90<br>150 | 0.8<br>2.0 | 3.5<br>6.8 | 275000<br>125000 | 1100<br>1350 | — | — | — | 1AB5 |
| 1B7GT # | Heptode | O. | 7Z | 1.4 | 0.1 | — | — | — | Converter | 90 | 0 | 45 | 1.3 | 1.5 | 350000 | Grid No. 1 resistor 200,000 ohms | | | | 1B7GT |
| 1B8GT | Diode Triode Pentode | O. | 8AW | 1.4 | 0.1 | — | — | — | Triode Amplifier<br>Pentode Amp. | 90<br>90 | 0<br>−6.0 | —<br>90 | —<br>1.4 | 0.15<br>6.3 | 240000<br>— | 275<br>1150 | —<br>— | —<br>14000 | —<br>210 | 1B8GT |
| 1C5GT | Pentode Power Amplifier | O. | 6X | 1.4 | 0.1 | — | — | — | Class-$A_1$ Amp. | 90 | −7.5 | 90 | 1.6 | 7.5 | 115000 | 1550 | 165 | 8000 | 240 | 1C5GT |
| 1D8GT | Diode Triode Pentode | O. | 8AJ | 1.4 | 0.1 | — | — | — | Triode Amp.<br>Pentode Amp. | 90<br>90 | 0<br>−9.0 | —<br>90 | —<br>1.0 | 1.1<br>5.0 | 43500<br>200000 | 575<br>925 | 25<br>— | —<br>— | —<br>— | 1D8GT |
| 1E4G | Triode Amplifier | O. | 5S | 1.4 | 0.05 | 2.4 | 6 | 2.40 | Class-A Amp. | 90<br>90 | 0<br>−3.0 | — | — | 4.5<br>1.5 | 11000<br>17000 | 1325<br>825 | 14.5<br>14 | — | — | 1E4G |
| 1G4GT | Triode Amplifier | O. | 5S | 1.4 | 0.05 | 2.2 | 3.4 | 2.80 | Class-A Amp. | 90 | −6.0 | — | — | 2.3 | 10700 | 825 | 8.8 | — | — | 1G4GT |
| 1G6GT | Twin Triode | O. | 7AB | 1.4 | 0.1 | — | — | — | Class-A Amp.<br>Class-B Amp. | 90<br>90 | 0<br>0 | — | — | 1.0<br>1/7 | 45000<br>34 volts input per grid | 675 | 30 | —<br>12000 | —<br>675 | 1G6GT |
| 1H5GT | Diode High-μ Triode | O. | 5Z | 1.4 | 0.05 | 1.1 | 6 | 1.00 | Class-A Amp. | 90 | 0 | — | — | 0.14 | 240000 | 275 | 65 | — | — | 1H5GT |
| 1LA4 | Pentode Power Amplifier | L. | 5AD | 1.4 | 0.05 | — | — | — | Class-A Amp. | 90 | Characteristics same as 1A5GT | | | | | | | | | 1LA4 |
| 1LA6 | Pentagrid Converter | L. | 7AK | 1.4 | 0.05 | — | — | — | Converter | 90 | 0 | 45 | 0.6 | 0.55 | Anode Grid Volts 90 | | | | | 1LA6 |
| 1LB4 | Pentode Power Amplifier | L. | 5AD | 1.4 | 0.05 | — | — | — | Class-A Amp. | 90 | −9 | 90 | 1.0 | 5.0 | 200000 | 925 | — | 12000 | 200 | 1LB4 |
| 1LB6 | Heptode Converter | L. | 8AX | 1.4 | 0.05 | — | — | — | Converter | 90 | 0 | 67.5 | 2.2 | 0.4 | Grid No. 4—67.5 v., No. 5—0 v. | | | | | 1LB6 |
| 1LC5 | Remote Cut-off Pentode | L. | 7AO | 1.4 | 0.05 | 3.2 | 7 | .007 | R.F. Amplifier | 90 | 0 | 45 | 0.2 | 1.15 | 1500000 | 775 | — | — | — | 1LC5 |
| 1LC6 | Pentagrid Converter | L. | 7AK | 1.4 | 0.05 | — | — | — | Converter | 90 | 0 | 35 [1] | 0.7 | 0.75 | Anode Grid Volts 45 | | | | | 1LC6 |
| 1LD5 | Diode Pentode | L. | 6AX | 1.4 | 0.05 | 3.2 | 6 | 0.18 | Class-A Amp. | 90 | 0 | 45 | 0.1 | 0.6 | 950000 | 600 | — | — | — | 1LD5 |
| 1LE3 | Triode Amplifier | L. | 4AA | 1.4 | 0.05 | 1.7 | 3 | 1.70 | Class-A Amp. | 90<br>90 | 0<br>−3 | — | — | 4.5<br>1.3 | 11200<br>19000 | 1300<br>760 | 14.5 | — | — | 1LE3 |
| 1LG5 | Pentode R.F. Amp. | L. | 7AO | 1.4 | 0.05 | — | — | — | Class-A Amp. | 90 | 0 | 45 | 0.4 | 1.7 | 1000000 | 800 | — | — | — | 1LG5 |
| 1LH4 | Diode High-μ Triode | L. | 5AG | 1.4 | 0.05 | 1.1 | 6 | 1.00 | Class-A Amp. | 90 | 0 | — | — | 0.15 | 240000 | 275 | 65 | — | — | 1LH4 |
| 1LN5 | Remote Cut-off Pentode | L. | 7AO | 1.4 | 0.05 | 3.4 | 8 | .007 | Class-A Amp. | 90 | 0 | 90 | 0.3 | 1.2 | 1500000 | 750 | — | — | — | 1LN5 |
| 1N5GT | Remote Cut-off Pentode | O. | 5Y | 1.4 | 0.05 | 3 | 10 | .007 | Class-A Amp. | 90 | 0 | 90 | 0.3 | 1.2 | 1500000 | 750 | 1160 | — | — | 1N5GT |
| 1N6G [4] | Diode-Power-Pentode | O. | 7AM | 1.4 | 0.05 | — | — | — | Class-A Amp. | 90 | −4.5 | 90 | 0.6 | 3.1 | 300000 | 800 | — | 25000 | 100 | 1N6G |
| 1P5GT | Pentode | O. | 5Y | 1.4 | 0.05 | 3 | 10 | .007 | R.F. Amplifier | 90 | 0 | 90 | 0.7 | 2.3 | 800000 | 800 | 640 | — | — | 1P5GT |
| 1Q5GT | Tetrode Power Amplifier | O. | 6AF | 1.4 | 0.1 | — | — | — | Class-A Amp. | 85<br>90 | −5.0<br>−4.5 | 85<br>90 | 1.2<br>1.6 | 7.2<br>9.5 | 70000<br>75000 | 1950<br>2100 | — | 9000<br>8000 | 250<br>270 | 1Q5GT |
| 1R4/1294 | U.h.f. Diode | L. | 4AH | 1.4 | 0.15 | — | — | — | Rectifier | Max. r.m.s. voltage per plate—30 | | | | | Max. d.c. output current—340 μa. | | | | | 1R4/1294 |
| 1SA6GT | Medium Cut-off Pentode | O. | 6CA | 1.4 | 0.05 | 5.2 | 8.6 | 0.01 | R.F. Amplifier | 90 | 0 | 67.5 | 0.68 | 2.45 | 800000 | 970 | — | — | — | 1SA6GT |
| 1SB6GT | Diode Pentode | O. | 6CB | 1.4 | 0.05 | 3.2 | 3 | 0.25 | Class-A Amp. | 90 | 0 | 67.5 | 0.38 | 1.45 | 700000 | 665 | — | — | — | 1SB6GT |
| | | | | | | | | | R.C. Amplifier | 90 | 0 | 90 | Screen resistor 5 meg., grid 10 meg. | | | | | 1 meg. | 110 [2] | |
| 1T5GT | Beam Power Amplifier | O. | 6AF | 1.4 | 0.05 | 4.8 | 8 | 0.50 | Class-A Amp. | 90 | −6.0 | 90 | 1.4 | 6.5 | — | 1150 | — | 14000 | 170 | 1T5GT |
| 3B7/1291 | U.h.f. Twin Triode | L. | 7BE | 2.8 [3] | 0.11 | 1.4 | 2.6 | 2.6 | Class-A Amp. | 90 | 0 | — | — | 5.2 | 11350 | 1850 | 21 | — | — | 3B7/1291 |
| 1293 | U.h.f. Triode | L. | 4AA | 1.4 | 0.11 | 1.7 | 3.0 | 1.7 | Class-A Amp. | 90 | 0 | — | — | 4.7 | 10750 | 1300 | 14 | — | — | 1293 |
| 3D6/1299 | U.h.f. Tetrode | L. | 6BB | 2.8 [3] | 0.11 | 7.5 | 6.5 | 0.30 | Class-A Amp. | 135 | −6 | 90 | 0.7 | 5.7 | — | 2200 | — | 13000 | 500 | 3D6/1299 |
| 3E6 | R.F. Pentode | L. | 7CJ | 1.4<br>2.8 | 0.10<br>0.05 | 5.5 | 7.5 | 0.007 | Class-A Amp. | 90 | 0 | 90 | 1.3 | 3.8 | 300000 | 2100 | — | — | — | 3E6 |
| RK42 | Triode Amplifier | S. | 4D | 1.5 | 0.6 | — | — | — | Class-A Amp. | Characteristics same as Type 30—Table VI | | | | | | | | | | RK42 |
| RK43 | Twin Triode Amplifier | S. | 6C | 1.5 | 0.12 | — | — | — | Class-A Amp. | 135 | −3 | — | — | 4.5 | 14500 | 900 | 13 | — | — | RK43 |

# Discontinued. [1] Through series resistor. Screen voltage must be at least 10 volts lower than oscillator anode. [2] Voltage gain. [3] Center-top filament permits 1.4-volt operation.

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## TABLE IX—HIGH-VOLTAGE HEATER TUBES

| Type | Name | Base | Socket Connections | Heater Volts | Heater Amp. | Capacitance μμfd. In | Out | Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12A5[8] | Pentode Power Amplifier | M. | 7F | 12.6<br>6.3 | 0.3<br>0.6 | 9.0 | 9.0 | 0.3 | Class-$A_1$ Amp.[6] | 100<br>180 | −15<br>−25 | 100<br>180 | 3/6.5<br>8/14 | 17/19<br>45/48 | 50000<br>35000 | 1700<br>2400 | —<br>— | 4500<br>3300 | 0.8<br>3.4 | 12A5 |
| 12A6 | Beam Power Amplifier | O. | 7AC | 12.6 | 0.15 | — | — | — | Class-A Amp. | 250 | −12.5 | 250 | 3.5 | 30 | 70000 | 3000 | — | 7500 | 3.4 | 12A6 |
| 12A7 | Rectifier-Amplifier | M. | 7K | 12.6 | 0.3 | — | — | — | Class-A Amp. | 135 | −13.5 | 135 | 2.5 | 9.0 | 102000 | 975 | 100 | 13500 | 0.55 | 12A7 |
| 12A8GT | Heptode | O. | 8A | 12.6 | 0.15 | 9.5 | 12 | 0.26 | Converter | Characteristics same as 6A8—Table I | | | | | | | | | | 12A8GT |
| 12AH7GT | Twin Triode | O. | 8BE | 12.6 | 0.15 | Each Triode Sect. | | | Class-A Amp. | 180 | − 6.5 | — | — | 7.6 | 8400 | 1900 | 16 | — | — | 12AH7GT |
| 12B6M | Diode Triode | O. | 6Y | 12.6 | 0.15 | — | — | — | Class-A Amp. | 250 | − 2.0 | — | — | 0.9 | 91000 | 1100 | 100 | — | — | 12B6M |
| 12B7ML | Pentode Amplifier | O. | 8V | 12.6 | 0.15 | — | — | — | Class-A Amp. | 250 | − 3.0 | 100 | 2.6 | 9.2 | 800000 | 2000 | — | — | — | 12B7ML |
| 12B8GT[8] | Triode-Pentode | O. | 8T | 12.6 | 0.3 | Triode Section<br>Pentode Section | | | Class-A Amp.<br>Class-A Amp. | 100<br>100 | − 1<br>− 3 | —<br>100 | —<br>2 | 0.6<br>8 | 73000<br>170000 | 1500<br>2100 | 110<br>360 | —<br>— | —<br>— | 12B8GT |
| 12C8 | Duplex-Diode Pentode | O. | 8E | 12.6 | 0.15 | 6 | 9 | .005 | Class-A Amp. | Characteristics same as 6B8—Table I | | | | | | | | | | 12C8 |
| 12E5GT | Triode Amplifier | O. | 6Q | 12.6 | 0.15 | 3.4 | 5.5 | 2.60 | Class-A Amp. | 250 | −13.5 | — | — | 50 | — | 1450 | 13.8 | — | — | 12E5GT |
| 12F5GT | Triode Amplifier | O. | 5M | 12.6 | 0.15 | 1.9 | 3.4 | 2.40 | Class-A Amp. | Characteristics same as 6SF5—Table I | | | | | | | | | | 12F5GT |
| 12G7G | Duplex-Diode Triode | O. | 7V | 12.6 | 0.15 | — | — | — | Class-A Amp. | 250 | − 3.0 | — | — | — | 58000 | 1200 | 70 | — | — | 12G7G |
| 12H6 | Twin Diode | O. | 7Q | 12.6 | 0.15 | — | — | — | Rectifier | Characteristics same as 6H6—Table I | | | | | | | | | | 12H6 |
| 12J5GT | Triode Amplifier | O. | 6Q | 12.6 | 0.15 | 3.4 | 3.6 | 3.40 | Class-A Amp. | Characteristics same as 6J5—Table I | | | | | | | | | | 12J5GT |
| 12J7GT | Sharp Cut-off Pentode | O. | 7R | 12.6 | 0.15 | 4.2 | 5.0 | 3.8 | Class-A Amp. | Characteristics same as 6J7—Table I | | | | | | | | | | 12J7GT |
| 12K7GT | Remote Cut-off Pentode | O. | 7R | 12.6 | 0.15 | 4.6 | 12 | .005 | R.F. Amplifier | Characteristics same as 6K7—Table I | | | | | | | | | | 12K7GT |
| 12K8 | Triode Hexode Converter | O. | 8K | 12.6 | 0.15 | — | — | — | Converter | Characteristics same as 6K8—Table I | | | | | | | | | | 12K8 |
| 12L8GT | Twin Pentode | O. | 8BU | 12.6 | 0.15 | 5 | 6 | 0.70 | Class-$A_1$ Amp. | 180 | − 9.0 | 180 | 2.8 | 13.0 | 160000 | 2150 | — | 10000 | 1.0 | 12L8GT |
| 12Q7GT | Duplex-Diode Triode | O. | 7V | 12.6 | 0.15 | 2.2 | 5 | 1.60 | Class-A Amp. | Characteristics same as 6Q7—Table I | | | | | | | | | | 12Q7GT |
| 12S8GT | Triple-Diode Triode | O. | 8CB | 12.6 | 0.15 | 2.0 | 3.8 | 1.2 | Class-A Amp. | 250 | − 2.0 | — | — | 0.9 | 91000 | 1100 | 100 | — | — | 12S8GT |
| 12SA7 | Heptode | O. | 8R | 12.6 | 0.15 | 9.5 | 12 | 0.13 | Converter | Characteristics same as 6SA7—Table I | | | | | | | | | | 12SA7 |
| 12SC7 | Twin Triode | O. | 8S | 12.6 | 0.15 | 2.2 | 3.0 | 2.0 | Class-A Amp. | Characteristics same as 6SC7—Table I | | | | | | | | | | 12SC7 |
| 12SF5 | High-$\mu$ Triode | O. | 6AB | 12.6 | 0.15 | 4 | 3.6 | 2.40 | Class-A Amp. | Characteristics same as 6SF5—Table I | | | | | | | | | | 12SF5 |
| 12SF7 | Diode Variable-$\mu$ Pentode | O. | 7AZ | 12.6 | 0.15 | 5.5 | 6.0 | .004 | Class-A Amp. | Characteristics same as 6SF7—Table I | | | | | | | | | | 12SF7 |
| 12SG7 | Medium Cut-off Pentode | O. | 8BK | 12.6 | 0.15 | 8.5 | 7.0 | .003 | Class-A Amp. | Characteristics same as 6SG7—Table I | | | | | | | | | | 12SG7 |
| 12SH7 | Sharp Cut-off Pentode | O. | 8BK | 12.6 | 0.15 | 8.5 | 7.0 | .003 | H-F Amplifier | Characteristics same as 6SH7—Table I | | | | | | | | | | 12SH7 |
| 12SJ7 | Sharp Cut-off Pentode | O. | 8N | 12.6 | 0.15 | — | — | — | Class-A Amp. | Characteristics same as 6SJ7—Table I | | | | | | | | | | 12SJ7 |
| 12SK7 | Remote Cut-off Pentode | O. | 8N | 12.6 | 0.15 | 6.0 | 7.0 | .003 | R.F. Amplifier | Characteristics same as 6SK7—Table I | | | | | | | | | | 12SK7 |
| 12SL7GT | Twin Triode | O. | 8BD | 12.6 | 0.15 | — | — | — | Class-A Amp. | Characteristics same as 6SL7GT—Table II | | | | | | | | | | 12SL7GT |
| 12SN7GT | Twin Triode | O. | 8BD | 12.6 | 0.3 | — | — | — | Class-A Amp. | Characteristics same as 6SN7GT—Table II | | | | | | | | | | 12SN7GT |
| 12SQ7 | Duplex-Diode Triode | O. | 8Q | 12.6 | 0.15 | 3.2 | 3.0 | 1.60 | Class-A Amp. | Characteristics same as 6SQ7—Table I | | | | | | | | | | 12SQ7 |
| 12SR7 | Duplex-Diode Triode | O. | 8Q | 12.6 | 0.15 | 3.6 | 2.8 | 2.40 | Class-A Amp. | Characteristics same as 6R7—Table I | | | | | | | | | | 12SR7 |
| 12SW7 | Duplex-Diode Triode | O. | 8Q | 12.6 | 0.15 | 3.0 | 2.8 | 2.4 | Class-$A_1$ Amp. | 250 | − 9 | — | — | 9.5 | 8500 | 1900 | 16 | — | — | 12SW7 |
| 12SX7 | Twin Triode | O. | 8BD | 12.6 | 0.3 | 3.0 | 0.8 | 3.6 | Class-$A_1$ Amp.[3] | 250 | − 8 | — | — | 9 | 7700 | 2600 | 20 | — | — | 12SX7 |
| 12SY7 | Heptode Converter | O. | 8R | 12.6 | 0.15 | Osc.-Grid leak 20000 ohms | | | Converter | 250 | − 2 | 100 | 8.5 | 3.5 | 1000000 | 450 | — | — | — | 12SY7 |
| 14A4 | Triode Amplifier | L. | 5AC | 14 | 0.16 | 3.4 | 3.0 | 4.00 | Class-A Amp. | Characteristics same as 7A4—Table III | | | | | | | | | | 14A4 |
| 14A5 | Beam Power Amplifier | L. | 6AA | 14 | 0.16 | — | — | — | Class-$A_1$ Amp. | 250 | −12.5 | 250 | 3.5/5.5 | 30/32 | 70000 | 3000 | — | 7500 | 2.8 | 14A5 |
| 14A7/<br>12B7 | Remote Cut-off Pentode | L. | 8V | 14 | 0.16 | 6.0 | 7.0 | .005 | Class-A Amp. | 250 | − 3.0 | 100 | 2.6 | 9.2 | 800000 | 2000 | — | — | — | 14A7/<br>12B7 |
| 14AF7 | Twin Triode | L. | 8AC | 14 | 0.16 | 2.2 | 1.6 | 2.30 | Class-A Amp. | 250 | −10 | — | — | 9 | 7600 | 2100 | 16 | — | — | 14AF7 |
| 14B6 | Duplex-Diode Triode | L. | 8W | 14 | 0.16 | — | — | — | Class-A Amp. | Characteristics same as 7B6—Table III | | | | | | | | | | 14B6 |
| 14B8 | Pentagrid Converter | L. | 8X | 14 | 0.16 | Ic2 = 4 Ma. | | | Converter | Characteristics same as 7B8—Table III | | | | | | | | | | 14B8 |
| 14C5 | Beam Power Amplifier | L. | 6AA | 14 | 0.24 | — | — | — | Class-A Amp. | Characteristics same as 6V6—Table I | | | | | | | | | | 14C5 |

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## TABLE IX—HIGH-VOLTAGE HEATER TUBES—*Continued*

| Type | Name | Base | Socket Connections | Heater | | Capacitance μμfd. | | | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Volts | Amp. | In | Out | Plate-Grid | | | | | | | | | | | | |
| 14C7 | R.F. Pentode | L. | 8V | 14 | 0.16 | 6.0 | 6.5 | .007 | Class-A Amp. | 250 | — 3.0 | 100 | 0.7 | 2.2 | 1000000 | 1575 | — | — | — | 14C7 |
| 14E6 | Duplex-Diode Triode | L. | 8W | 14 | 0.16 | — | — | — | Class-A Amp. | Characteristics same as 7E6—Table III | | | | | | | | | | 14E6 |
| 14E7 | Duplex-Diode Pentode | L. | 8AE | 14 | 0.16 | 4.6 | 5.3 | .005 | Class-A Amp. | Characteristics same as 7E7—Table III | | | | | | | | | | 14E7 |
| 14F7 | Twin Triode | L. | 8AC | 14 | 0.16 | — | — | — | Class-A Amp. | Characteristics same as 7F7—Table III | | | | | | | | | | 14F7 |
| 14F8 | Twin Triode | L. | 8BW | 12.6 | 0.15 | 2.8 | 1.4 | 1.2 | Class-$A_1$ Amp. | Characteristics same as 7F8 | | | | | | | | | | 14F8 |
| 14H7 | Semi-Variable-$\mu$ Pentode | L. | 8V | 14 | 0.16 | 8.0 | 7.0 | .007 | Class-A Amp. | 250 | — 2.5 | 150 | 3.5 | 9.5 | 800000 | 3800 | — | — | — | 14H7 |
| 14J7 | Triode-Hexode Converter | L. | 8BL | 14 | 0.16 | Ipt = 5 Ma. | | | Converter | Characteristics same as 7J7—Table III | | | | | | | | | | 14J7 |
| 14N7 | Twin Triode | L. | 8AC | 14 | 0.32 | — | — | — | Class-A Amp. | Characteristics same as 7N7—Table III | | | | | | | | | | 14N7 |
| 14Q7 | Heptode Pentagrid Converter | L. | 8AL | 14 | 0.16 | — | — | — | Converter | Characteristics same as 7Q7—Table III | | | | | | | | | | 14Q7 |
| 14R7 | Duplex-Diode Pentode | L. | 8AE | 14 | 0.16 | 5.6 | 5.3 | .004 | Class-A Amp. | Characteristics same as 7R7—Table III | | | | | | | | | | 14R7 |
| 14S7 | Triode Heptode | L. | 8BL | 14 | 0.16 | Ipt = 5 Ma. | | | Converter | 250 | — 2.0 | 100 | 3 | 1.8 | 1250000 | 525 | — | — | — | 14S7 |
| 14V7 | H.f. Pentode | L. | 8V | 14 | 0.24 | — | — | — | Class-A Amp. | 300 | — 2.0 | 150 | 3.9 | 9.6 | 300000 | 5800 | — | — | — | 14V7 |
| 14W7 | Pentode | L. | 8BJ | 14 | 0.24 | Rk = 160 ohms | | | Class-A Amp. | 300 | — 2.2 | 150 | 3.9 | 10 | 300000 | 5800 | — | — | — | 14W7 |
| 18 | Pentode | M. | 6B | 14 | 0.30 | — | — | — | Class-A Amp. | Characteristics same as 6F6G | | | | | | | | | | 18 |
| 19BG6G | Beam Power Amp. | O. | 5BT | 18.9 | 0.3 | 11 | 6.5 | 0.65 | Deflection Amp. | 400 | Peak surge $E_P$ = 4000 V. Peak surge $E_G$ = −100 V. $I_{G2}$ = 6 ma. $I_P$ = 70 ma. | | | | | | | | | | 19BG6G |
| 20J8GM | Triode Heptode Converter | O. | 8H | 20 | 0.15 | — | — | — | Converter | 250 | — 3.0 | 100 | 3.4 | 1.5 | Triode Plate (No. 6) 100 v. 1.5 ma. | | | | | 20J8GM |
| 21A7 | Triode Hexode Converter | L. | 8AR | 21 | 0.16 | — | — | — | Converter | 250<br>150 | — 3.0<br>— 3.0 | 100 | 2.8<br>Triode | 1.3<br>3.5 | —<br>— | 275<br>1900 | —<br>32 | —<br>— | —<br>— | 21A7 |
| 25A6 [8] | Pentode Power Amplifier | O. | 7S | 25 | 0.3 | 8.5 | 12.5 | 0.20 | Class-A Amp. | 135 | −20.0 | 135 | 8 | 37 | 35000 | 2450 | 85 | 4000 | 2.0 | 25A6 |
| 25A7GT [8] | Rectifier Power Pentode | O. | 8F | 25 | 0.3 | — | — | — | Class-A Amp. | 100 | −15.0 | 100 | 4 | 20.5 | 50000 | 1800 | 90 | 4500 | 0.77 | 25A7GT |
| 25AC5GT [8] | Triode Power Amplifier | O. | 6Q | 25 | 0.3 | — | — | — | Class-A Amp. | 110 | +15.0 | — | — | 45 | — | 3800 | 58 | 2000 | 2.0 | 25AC5GT |
| | | | | | | | | | | 165 | Used in dynamic-coupled circuit with 6AF5G driver | | | | | | | 3500 | 3.3 | |
| 25B5 [8] | Direct-Coupled Triodes | S. | 6D | 25 | 0.3 | — | — | — | Class-A Amp. | 110 | 0 | 110 | 7 | 45 | 11400 | 2200 | 25 | 2000 | 2.0 | 25B5 |
| 25B6G [8] | Pentode Power Amplifier | O. | 7S | 25 | 0.3 | — | — | — | Class-A Amp. | 95 | −15.0 | 95 | 4 | 45 | — | 4000 | — | 2000 | 1.75 | 25B6G |
| 25B8GT [8] | Triode Pentode | O. | 8T | 25 | 0.15 | — | — | — | Class-A Amp. | Characteristics same as 12B8GT | | | | | | | | | | 25B8GT |
| 25BQ6GT | Beam Pentode | O. | 6AM | 25 | 0.3 | — | — | — | Deflection Amp. | 250 | 47* | 150 | 2.1 | 45 | — | 5500 | — | — | — | 25BQ6GT |
| 25C6G [8] | Beam Power Amplifier | O. | 7AC | 25 | 0.3 | — | — | — | Class-$A_1$ Amp. | 135 | −13.5 | 135 | 3.5/11.5 | 58/60 | 9300 | 7000 | — | 2000 | 3.6 | 25C6G |
| 25D8GT | Diode Triode Pentode | O. | 8AF | 25 | 0.15 | — | — | — | Triode Amp. | 100 | — 1.0 | — | — | 0.5 | 91000 | 1100 | 100 | — | — | 25D8GT |
| | | | | | | | | | Pentode Amp. | 100 | — 3.0 | 100 | 2.7 | 8.5 | 200000 | 1900 | — | — | — | |
| 25L6 | Beam Power Amplifier | O. | 7AC | 25 | 0.3 | 16 | 13.5 | 0.30 | Class-$A_1$ Amp. | 110 | — 8.0 | 110 | 3.5/10.5 | 45/48 | 10000 | 8000 | 80 | 2000 | 2.2 | 25L6 |
| 25N6G [8] | Direct-Coupled Triodes | O. | 7W | 25 | 0.3 | — | — | — | Class-A Amp. | 110 | 0 | 110 | 7 | 45 | 11400 | 2200 | 25 | 2000 | 2.0 | 25N6G |
| 26A7GT | Twin Beam-Power Audio Amplifier | O. | 8BU | 26.5 | 0.6 | Each Unit Push-Pull | | | Class-A Amp. | 26.5 | — 4.5 | 26.5 | 2/5.5 | 20/20.5 | 2500 | 5500 | — | 1500 | 0.2 | 26A7GT |
| | | | | | | | | | Class-AB Amp. [3] | 26.5 | — 7.0 | 26.5 | 2/8.5 | 19/30 | — | — | — | 2500 [4] | 0.5 | |
| 32L7GT | Diode-Beam Tetrode | O. | 8Z | 32.5 | 0.3 | — | — | — | Class-A Amp. | 110 | — 7.5 | 110 | 3 | 40 | 15000 | 6000 | — | 2500 | 1.5 | 32L7GT |
| 35A5 | Beam Power Amplifier | L. | 6AA | 35 | 0.15 | — | — | — | Class-$A_1$ Amp. | 110 | — 7.5 | 110 | 3/7 | 40/41 | 14000 | 5800 | — | 2500 | 1.5 | 35A5 |
| 35L6G | Beam Power Amplifier | O. | 7AC | 35 | 0.15 | 13 | 9.5 | 0.80 | Class-$A_1$ Amp. | 110 | — 7.5 | 110 | 3/7 | 40/41 | 13800 | 5800 | — | 2500 | 1.5 | 35L6G |
| 43 | Pentode Power Amplifier | M. | 6B | 25 | 0.3 | 8.5 | 12.5 | 0.20 | Class-A Amp. | 95 | −15.0 | 95 | 4.0 | 20.0 | 45000 | 2000 | 90 | 4500 | 0.90 | 43 |
| 48 [8] | Tetrode Power Amplifier | M. | 6A | 30 | 0.4 | — | — | — | Class-A Amp. | 96 | −19.0 | 96 | 9.0 | 52.0 | — | 3800 | — | 1500 | 2.0 | 48 |
| 50A5 | Beam Power Amplifier | L. | 6AA | 50 | 0.15 | — | — | — | Class-$A_1$ Amp. | 110 | — 7.5 | 110 | 4/11 | 49/50 | 10000 | 8200 | — | 2000 | 2.2 | 50A5 |
| 50C6GT | Beam Power Amplifier | O. | 7AC | 50 | 0.15 | — | — | — | Class-$A_1$ Amp. | 135 | −13.5 | 135 | 3.5/11.5 | 58/60 | 9300 | 7000 | — | 2000 | 3.6 | 50C6GT |
| 50L6GT | Beam Power Amplifier | O. | 7AC | 50 | 0.15 | — | — | — | Class-A Amp. | 110 | — 7.5 | 110 | 4/11 | 49/50 | — | 8200 | 82 | 2000 | 2.2 | 50L6GT |
| 70A7GT | Diode-Beam Tetrode | O. | 8AB [1] | 70 | 0.15 | — | — | — | Class-A Amp. | 110 | — 7.5 | 110 | 3.0 | 40 | — | 5800 | 80 | 2500 | 1.5 | 70A7GT |
| 70L7GT | Diode-Beam Tetrode | O. | 8AA | 70 | 0.15 | — | — | — | Class-$A_1$ Amp. | 110 | — 7.5 | 110 | 3/6 | 40/43 | 15000 | 7500 | — | 2000 | 1.8 | 70L7GT |
| 117L7GT/ 117M7GT | Rectifier-Amplifier | O. | 8AO | 117 | 0.09 | — | — | — | Class-A Amp. | 105 | — 5.2 | 105 | 4/5.5 | 43 | 17000 | 5300 | — | 4000 | 0.85 | 117L7GT/ 117M7GT |
| 117N7GT | Rectifier-Amplifier | O. | 8AV | 117 | 0.09 | — | — | — | Class-A Amp. | 100 | — 6.0 | 100 | 5.0 | 51 | 16000 | 7000 | — | 3000 | 1.2 | 117N7GT |
| 117P7GT | Rectifier-Amplifier | O. | 8AV | 117 | 0.09 | — | — | — | Class-A Amp. | 105 | — 5.2 | 105 | 4/5.5 | 43 | 17000 | 5300 | — | 4000 | 0.85 | 117P7GT |

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## TABLE IX—HIGH-VOLTAGE HEATER TUBES—*Continued*

| Type | Name | Base | Socket Connections | Heater Volts | Heater Amp. | Capacitance µµfd. In | Capacitance µµfd. Out | Capacitance µµfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1280 | Pentode | L. | 8V | 12.6 | 0.15 | 6.0 | 6.5 | 0.007 | Class-$A_1$ Amp. | Same as 14C7 (Special Non-microphonic) | | | | | | | | | | 1280 |
| 1284 | U.h.f. Pentode | L. | 8V | 12.6 | 0.15 | 5.0 | 6.0 | 0.01 | Class-A Amp. | 250 | — 3.0 | 100 | 2.5 | 9.0 | 800000 | 2000 | — | — | — | 1284 |
| 1629 | Electron-Ray Tube | O. | 6RA | 12.6 | 0.15 | — | — | — | Indicator Tube | Characteristics same as 6E5—Table IV | | | | | | | | | | 1629 |
| 1631 | Beam Power Amplifier | O. | 7AC | 12.6 | 0.45 | — | — | — | Class-A Amp. | Characteristics same as 6L6—Table I | | | | | | | | | | 1631 |
| 1632 | Beam Power Amplifier | O. | 7AC | 12.6 | 0.6 | — | — | — | Class-A Amp. | Characteristics same as 25L6 | | | | | | | | | | 1632 |
| 1633 | Twin Triode | O. | 8BD | 25 | 0.15 | — | — | — | Class-A Amp. | Characteristics same as 6SN7GT—Table I | | | | | | | | | | 1633 |
| 1634 | Twin Triode | O. | 8S | 12.6 | 0.15 | — | — | — | Class-A Amp. | Characteristics same as 6SC7—Table I | | | | | | | | | | 1634 |
| 1644 | Twin Pentode | O. | Fig. 7 | 12.6 | 0.15 | — | — | — | Class-A Amp. | 180 | — 9.0 | 180 | 2.8/4.6 | 13 | 160000 | 2150 | — | 10000 | 1.0 | 1644 |
| XXD/ 14AF7 | Twin Triode | L. | 8AC | 12.6 | 0.15 | — | — | — | Class-A Amp. | 250 | —10 | — | — | 9.0 | — | 2100 | 16 | — | — | XXD/ 14AF7 |
| 28D7 | Double Beam Power Amplifier | L. | 8BS | 28.0 | 0.4 | — | — | — | Class-A Amp. | 28 | 390* | 28 [2] | 0.7 [2] | 9.0 [2] | — | — | — | 4000 [4] | 0.08 [2] | 28D7 |
| | | | | | | | | | | | 180* | 28 [3] | 1.2 [3] | 18.5 [3] | — | — | — | 6000 [4] | 0.175 [2] | |

* Cathode resistor—ohms.

[1] 6.3-volt pilot lamp must be connected between Pins 6 and 7.
[2] Per section—resistance-coupled.
[3] P.p. operation—values for both sections.
[4] Plate to plate.
[5] Values are for each unit.
[6] Values are for single tube.
[7] Grids 2 and 3 connected to plate.
[8] Discontinued.

## TABLE X—SPECIAL RECEIVING TUBES

| Type | Name | Base | Socket Connections | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance µµfd. In | Capacitance µµfd. Out | Capacitance µµfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00-A [7] | Triode Detector | M. | 4D | 5.0 | 0.25 | 3.2 | 2.0 | 8.50 | Grid-Leak Det. | 45 | — | — | — | 1.5 | 30000 | 666 | 20 | — | — | 00-A |
| 01-A [7] | Triode Detector Amplifier | M. | 4D | 5.0 | 0.25 | — | — | — | Class-A Amp. | 135 | — 9.0 | — | — | 3.0 | 10000 | 800 | 8.0 | — | — | 01-A |
| 3A8GT | Diode Triode Pentode | O. | 8AS | 1.4 | 0.1 | 2.6 | 4.2 | 2.0 | Class-A Triode | 90 | 0 | — | — | 0.15 | 240000 | 275 | 65 | — | — | 3A8GT |
| | | | | 2.8 | 0.05 | 3.0 | 10.0 | 0.012 | Class-A Pentode | 90 | 0 | 90 | 0.3 | 1.2 | 600000 | 750 | — | — | — | |
| 3B5GT | Beam Power Amplifier | O. | 7AP | 1.4<br>2.8 | 0.1<br>0.05 | — | — | — | Class-A Amp. | 67.5 | — 7.0 | 67.5 | 0.6<br>0.5 | 3.0<br>6.7 | 100000 | 1650<br>1500 | — | 5000 | 0.2<br>0.18 | 3B5GT |
| 3C5GT | Power Output Pentode | O. | 7AQ | 1.4<br>2.8 | 0.1<br>0.05 | — | — | — | Class-A Amp. | 90 | — 9.0 | 90 | 1.4 | 6.0 | — | 1550<br>1450 | — | 8000<br>10000 | 0.24<br>0.26 | 3C5GT |
| 3C6 | Twin Triode | L. | 7BW | 1.4<br>2.8 | 0.1<br>0.05 | — | — | — | Class-A Amp. | 90 | 0 | — | — | 4.5 | 11200 | 1300 | 14.5 | — | — | 3C6 |
| 3LE4 | Power Amplifier Pentode | L. | 6BA | 2.8 | 0.05 | — | — | — | Class-A Amp. | 90 | — 9.0 | 90 | 1.8 | 9.0 | 110000 | 1600 | — | 6000 | 0.30 | 3LE4 |
| 3LF4 | Power Amplifier Tetrode | L. | 6BB | 1.4<br>2.8 | 0.1<br>0.05 | — | — | — | Class-A Amp. | 90 | — 4.5 | 90 | 1.3<br>1.0 | 9.5<br>8.0 | 75000<br>80000 | 2200<br>2000 | — | 8000<br>7000 | 0.27<br>0.23 | 3LF4 |
| 3Q5GT | Beam Power Amplifier | O. | 7AQ | 1.4<br>2.8 | 0.1<br>0.05 | Parallel Filaments<br>Series Filaments | | | Class-A Amp. | 90 | — 4.5 | 90 | 1.3<br>1.0 | 9.5<br>7.5 | — | 2100<br>1900 | — | 8000 | 0.27<br>0.25 | 3Q5GT |
| 4A6G | Twin Triode Amplifier | O. | 8L | 4 | 0.06 | Triodes Parallel | | | Class-A Amp. | 90 | — 1.5 | — | — | 2.2 | 13300 | 1500 | 20 | — | — | 4A6G |
| | | | | 2 | 0.12 | Both Sections | | | Class-B Amp. | 90 | 0 | — | — | 4.6 | — | — | — | 3000 | 1.0 | |
| 6F4 | Acorn Triode | A. | 7BR | 6.3 | 0.225 | 2.0 | 0.6 | 1.90 | Class-A Amp. | 80 | 150* | — | — | 13.0 | 2900 | 5800 | 17 | — | — | 6F4 |
| 6L4 | U.H.F. Triode | A. | 7BR | 6.3 | 0.225 | 1.3 | 0.5 | 1.6 | Class-$A_1$ Amp. | 80 | 150* | — | — | 9.5 | 4400 | 6400 | 28 | — | — | 6L4 |
| 10 | Triode Power Amplifier | M. | 4D | 7.5 | 1.25 | 4.0 | 3.0 | 7.00 | Class-A Amp. | 425 | —39.0 | — | — | 18.0 | 5000 | 1600 | 8.0 | 10200 | 1.6 | 10 |
| 11/12 [7] | Triode Detector Amplifier | M. | 4F/4D | 1.1 | 0.25 | — | — | — | Class-A Amp. | 135 | —10.5 | — | — | 3.0 | 15000 | 440 | 6.6 | — | — | 11/12 |
| 20 [7] | Triode Power Amplifier | S. | 4D | 3.3 | 0.132 | 2.0 | 2.3 | 4.10 | Class-A Amp. | 135 | —22.5 | — | — | 6.5 | 6300 | 525 | 3.3 | 6500 | 0.11 | 20 |
| 22 [7] | Tetrode R.F. Amplifier | M. | 4K | 3.3 | 0.132 | 3.5 | 10 | 0.02 | Class-A Amp. | 135 | — 1.5 | 67.5 | 1.3 | 3.7 | 325000 | 500 | 160 | — | — | 22 |
| 26 | Triode Amplifier | M. | 4D | 1.5 | 1.05 | 2.8 | 2.5 | 8.10 | Class-A Amp. | 180 | —14.5 | — | — | 6.2 | 7300 | 1150 | 8.3 | — | — | 26 |
| 40 [7] | Triode Voltage Amplifier | M. | 4D | 5.0 | 0.25 | 2.8 | 2.2 | 2.00 | Class-A Amp. | 180 | — 3.0 | — | — | 0.2 | 150000 | 200 | 30 | — | — | 40 |
| 50 | Triode Power Amplifier | M. | 4D | 7.5 | 1.25 | 4.2 | 3.4 | 7.10 | Class-A Amp. | 450 | —84.0 | — | — | 55.0 | 1800 | 2100 | 3.8 | 4350 | 4.6 | 50 |

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## TABLE X—SPECIAL RECEIVING TUBES—*Continued*

| Type | Name | Base | Socket Connections | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71-A | Triode Power Amplifier | M. | 4D | 5.0 | 0.25 | 3.2 | 2.9 | 7.50 | Class-A Amp. | 180 | −43.0 | — | — | 20.0 | 1750 | 1700 | 3.0 | 4800 | 0.79 | 71-A |
| 99 [6] | Triode Detector Amplifier | S. | 4D | 3.3 | 0.063 | 2.5 | 2.5 | 3.30 | Class-A Amp. | 90 | − 4.5 | — | — | 2.5 | 15500 | 425 | 6.6 | — | — | 99 |
| 112A [7] | Triode Detector Amplifier | M. | 4D | 5.0 | 0.25 | — | — | — | Class-A Amp. | 180 | −13.5 | — | — | 7.7 | 4700 | 1800 | 8.5 | — | — | 112A |
| 182B/ 482B | Triode Amplifier | M. | 4D | 5.0 | 1.25 | — | — | — | Class-A Amp. | 250 | −35.0 | — | — | 18.0 | — | 1500 | 5.0 | — | — | 182B/ 482B |
| 183/483 [7] | Power Triode | M. | 4D | 5.0 | 1.25 | — | — | — | Class-A Amp. | 250 | −60.0 | — | — | 25.0 | 18000 | 1800 | 3.2 | 4500 | 2.0 | 183/483 |
| 485 [7] | Triode | S. | 5A | 3.0 | 1.3 | — | — | — | Class-A Amp. | 180 | − 9.0 | — | — | 6.0 | 9300 | 1350 | 12.5 | — | — | 485 |
| 864 | Triode Amplifier | S. | 4D | 1.1 | 0.25 | — | — | — | Class-A Amp. | 90 | − 4.5 | — | — | 2.9 | 13500 | 610 | 8.2 | — | — | 864 |
| 954 | Pentode Detector, Amplifier | A. | 5BB | 6.3 | 0.15 | 3.4 | 3.0 | 0.007 | Class-A Amp. | 250 | − 3.0 | 100 | 0.7 | 2.0 | 1.5 meg. | 1400 | 2000 | — | — | 954 |
| | | | | | | | | | Bias Detector | 250 | − 6.0 | 100 | — | Plate current to be adjusted to 0.1 ma. with no signal | | | | — | | |
| 955 | Triode Detector, Amplifier, Oscillator | A. | 5BC | 6.3 | 0.15 | 1.0 | 0.6 | 1.40 | Class-A Amp. | 250 | − 7.0 | — | — | 6.3 | 11400 | 2200 | 25 | — | — | 955 |
| | | | | | | | | | | 90 | − 2.5 | — | — | 2.5 | 14700 | 1700 | 25 | — | — | |
| 956 | Variable-μ Pentode R.F. Amplifier | A. | 5BB | 6.3 | 0.15 | 3.4 | 3.0 | 0.007 | Class-A Amp. | 250 | − 3.0 | 100 | 2.7 | 6.7 | 700000 | 1800 | 1440 | — | — | 956 |
| | | | | | | | | | Mixer | 250 | −10.0 | 100 | — | — | Oscillator peak volts—7 min. | | | — | | |
| 957 | Triode Detector, Amplifier, Oscillator | A. | 5BD | 1.25 | 0.05 | 0.3 | 0.7 | 1.20 | Class-A Amp. | 135 | − 5.0 | — | — | 2.0 | 20800 | 650 | 13.5 | — | — | 957 |
| 958 958-A | Triode A.F. Amplifier, Oscillator | A. | 5BD | 1.25 | 0.1 | 0.6 | 0.8 | 2.60 | Class-A Amp. | 135 | − 7.5 | — | — | 3.0 | 10000 | 1200 | 12 | — | — | 958 958-A |
| 959 | Pentode Detector, Amplifier | A. | 5BE | 1.25 | 0.05 | 1.8 | 2.5 | 0.015 | Class-A Amp. | 145 | − 3.0 | 67.5 | 0.4 | 1.7 | 800000 | 600 | 480 | — | — | 959 |
| 7E5/1201 | U.h.f. Triode | L. | 8BN | 6.3 | 0.15 | 3.6 | 2.8 | 1.50 | Class-A Amp. | 180 | − 3 | — | — | 5.5 | 12000 | — | 36 | — | — | 7E5/1201 |
| 7C4/1203 | U.h.f. Diode | L. | 4AH | 6.3 | 0.15 | — | — | — | Rectifier | | Max. r.m.s. voltage—150 | | | | Max. d.c. output current—8 ma. | | | | | 7C4/1203 |
| 7AB7/ 1204 | Sharp Cut-off Pentode | L. | 8BO | 6.3 | 0.15 | 3.5 | 4.0 | 0.06 | Class-A Amp. | 250 | − 2 | 100 | 0.6 | 1.75 | 800000 | 1200 | — | — | — | 7AB7/ 1204 |
| 1276 | Triode Power Amplifier | M. | 4D | 4.5 | 1.14 | — | — | — | Class-A Amp. | | | | Characteristics similar to 6A3 | | | | | | | 1276 |
| 1609 | Pentode Amplifier | S. | 5B | 1.1 | 0.25 | — | — | — | Class-A Amp. | 135 | − 1.5 | 67.5 | 0.65 | 2.5 | 400000 | 725 | 300 | — | — | 1609 |
| 9004 | U.h.f. Diode | A. | 4BJ | 6.3 | 0.15 | — | — | — | Detector | | | Max. a.c. voltage—117. Max. d.c. output current—5 ma. | | | | | | | | 9004 |
| 9005 | U.h.f. Diode | A. | 5BG | 3.6 | 0.165 | — | — | — | Detector | | | Max. a.c. voltage—117. Max. d.c. output current—1 ma. | | | | | | | | 9005 |
| EF-50 | Sharp Cut-off Pentode | L. | 9C | 6.3 | 0.3 | 8 | 5 | 0.007 | I.F.-R.F. Amp. | 250 | 150* | 250 | 3.1 | 10 | 600000 | 6300 | — | — | — | EF-50 |
| GL-2C44 GL-464A | U.h.f. Triode | O. | Fig. 17 | 6.3 | 0.75 | — | — | — | Class-A Amp. and Modulator | 250 | 100* | — | — | 25.0 | — | 7000 | — | — | — | GL-2C44 GL-464A |
| GL-446A GL-446B | U.h.f. Triode | O. | Fig. 19 | 6.3 | 0.75 | — | — | — | Oscillator, Amp. or Converter | 250 | 200* | — | — | 15.0 | — | 4500 | 45 | — | — | GL-446A GL-446B |
| 559 GL-559 | U.h.f. Diode | O. | Fig. 18 | 6.3 | 0.75 | — | — | — | Detector or trans. line switch | 5.0 | — | — | — | 24.0 | — | — | — | — | — | 559 GL-559 |
| NU-2C35 | Special Hi-Mu Triode | O. | Fig. 38 | 6.3 | 0.3 | 5.2 | 2.3 | 0.62 | Shunt Voltage Regulator | 8000 | −200 | — | — | 5.0 | 525000 | 950 | 500 | — | — | NU-2C35 |
| VT52 | Triode | M. | 4D | 7.0 | 1.18 | 5.0 | 3.0 | 7.7 | Class-A Amp. | 220 | −43.5 | — | — | 29.0 | 1650 | 2300 | 3.8 | 3800 | 1.0 | VT52 |
| X6030 | Diode | L. | Fig. 4 | 3.0 | 0.6 | — | — | — | Noise Diode | 90 | — | — | — | 4.0 | — | — | — | — | — | X6030 |

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## TABLE X—SPECIAL RECEIVING TUBES—*Continued*

| Type | Name | Base | Socket Connections | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| XXB | Twin-Triode Frequency Converter | L. | Fig. 9 | 2.8/ 1.4 3.2[3]/ 1.6 | 0.05/ 0.10 —— —— | —— | —— | —— | Converter[2] | 90[1] | 0 | —— | —— | 4.5[4] 4.5[5] | 11200[4] 11200[5] | 1300[4] 1300[5] | 14.5[1] | —— | —— | XXB |
| | | | | | | | | | | | — 3 | —— | —— | 1.4[4] 1.4[5] | 1900[4] 1900[5] | 760[4] 760[5] | 14.5[1] | —— | —— | |
| XXFM | Twin-Diode Triode | L. | 8BZ | 6.3 | 0.3 | —— | —— | —— | Class-A Amp. | 250 | — 1 | —— | —— | 1.9 | 6700 | 1500 | 100 | —— | —— | XXFM |
| | | | | | | | | | | 100 | 0 | —— | —— | 1.2 | 85000 | 1000 | 85 | —— | —— | |

* Cathode resistor—ohms.

[1] Both sections.
[2] Section No. 2 recommended for h.f.o.
[3] Dry battery operation.
[4] Section No. 1.
[5] Section No. 2.
[6] Same as X99. Type V99 is same, but socket connections are 4E.
[7] Discontinued.

## TABLE XI—MINIATURE RECEIVING TUBES

Other miniature types in Tables XIII and XV

| Type | Name | Base | Socket Connections | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor[4] | Load Resistance Ohms | Power Output Watts | Prototype |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1A3 | H. F. Diode | B. | 5AP | 1.4 | 0.15 | —— | —— | —— | Detector F.M. Discrim. | | Max. a.c. voltage per plate—117. | | | Max. output current—0.5 ma. | | | | | | —— |
| 1L4 | Sharp Cut-off Pentode | B. | 6AR | 1.4 | 0.05 | 3.6 | 7.5 | .008 | Class-A Amp. | 90 | 0 | 90 | 2.0 | 4.5 | 350000 | 1025 | —— | —— | —— | 1N5GT |
| 1R5 | Pentagrid Converter | B. | 7AT | 1.4 | 0.05 | —— | —— | —— | Converter | 90 | 0 | 67.5 | 3.0 | 1.7 | 500000 | 300 | Grid No. 1 100000 ohms | | | 1A7GT |
| 1S4 | Pentagrid Power Amp. | B. | 7AV | 1.4 | 0.1 | —— | —— | —— | Class-A Amp. | 90 | — 7.0 | 67.5 | 1.4 | 7.4 | 100000 | 1575 | —— | 8000 | 0.270 | 1Q5GT |
| 1S5 | Diode Pentode | B. | 6AU | 1.4 | 0.05 | —— | —— | —— | Class-A Amp. | 67.5 | 0 | 67.5 | 0.4 | 1.6 | 600000 | 625 | —— | —— | —— | —— |
| | | | | | | | | | R-Coupled Amp. | 90 | 0 | 90 | Screen resistor 3 meg., grid 10 meg. | | | | | 1 meg. | 0.050 | |
| 1T4 | Variable-μ Pentode | B. | 6AR | 1.4 | 0.05 | 3.6 | 7.5 | 0.01 | Class-A Amp. | 90 | 0 | 67.5 | 1.4 | 3.5 | 500000 | 900 | —— | —— | —— | 1P5GT |
| 1U4 | Sharp Cut-off Pentode | B. | 6AR | 1.4 | 0.05 | 3.6 | 7.5 | 0.01 | Class-A Amp. | 90 | 0 | 90 | 0.5 | 1.6 | 1500000 | 900 | —— | —— | —— | 1N5GT |
| 1U5 | Diode Pentode | B. | 6BW | 1.4 | 0.05 | —— | —— | —— | Class-A Amp. | 67.5 | 0 | 67.5 | 0.4 | 1.6 | 600000 | 625 | —— | —— | —— | —— |
| 2C51 | Twin Triode | B. | 8CJ | 6.3 | 0.3 | 2.2 | 1.0 | 1.3 | Class-$A_1$ Amp. | 150 | — 2 | —— | —— | 8.2[1] | —— | 5500 | 35 | —— | —— | 7F8 |
| 2E30 | Beam Power Pentode | B. | 7CQ | 6.0 | 0.7 | 10 | 4.5 | 0.5 | Class-$A_1$ Single | 250 | 450* | 250 | 7.4[2] | 44[2] | 63000 | 3700 | 40[5] | 4500 | 4.5 | —— |
| | | | | | | | | | Class-$A_1$ Amp.[3] | 250 | 225* | 250 | 14.8[2] | 88[2] | —— | —— | 80[5] | 9000[6] | 9 | |
| | | | | | | | | | Class-$AB_1$ Amp.[3] | 250 | —25 | 250 | 13.5[2] | 80[2] | —— | —— | 48[5] | 8000[6] | 12.5 | |
| | | | | | | | | | Class-$AB_2$ Amp.[3] | 250 | —30 | 250 | 20[2] | 120[2] | —— | —— | 40[5] | 3800[6] | 17 | |
| 3A4 | Power Amplifier Pentode | B. | 7BB | 1.4 2.8 | 0.2 0.1 | 4.8 | 4.2 | 0.34 | Class-$A_1$ Amp. | 135 150 | — 7.5 — 8.4 | 90 90 | 2.6 2.2 | 14.9[2] 14.1[2] | 90000 100000 | 1900 | —— | 8000 | 0.6 0.7 | —— |
| 3A5 | H.F. Twin Triode | B. | 7BC | 1.4 2.8 | 0.22 0.11 | 0.9 | 1.0 | 3.20 | Class-A Amp. | 90 | — 2.5 | —— | —— | 3.7 | 8300 | 1800 | 15 | —— | —— | —— |
| 3Q4 | Power Amplifier Pentode | B. | 7BA | 1.4 | 0.1 | Parallel Filaments | | | Class-A Amp. | 90 | — 4.5 | 90 | 2.1 | 9.5 | 100000 | 2150 | —— | 10000 | 0.27 | 3Q5GT |
| | | | | 2.8 | 0.05 | Series Filaments | | | | | | | 1.7 | 7.7 | 120000 | 2000 | | | 0.24 | |
| 3S4 | Power Amplifier Pentode | B. | 7BA | 1.4 | 0.1 | Parallel Filaments | | | Class-A Amp. | 90 | — 7.0 | 67.5 | 1.4 | 7.4 | 100000 | 1575 | —— | 8000 | 0.27 | 3Q5GT |
| | | | | 2.8 | 0.05 | Series Filaments | | | | | | | 1.1 | 6.1 | | 1425 | | | 0.235 | |
| 3V4 | Power Amplifier Pentode | B. | 6BX | 1.4 | 0.1 | Parallel Filaments | | | Class-A Amp. | 90 | — 4.5 | 90 | 2.1 | 9.5 | 100000 | 2150 | —— | 10000 | 0.27 | 3Q5GT |
| | | | | 2.8 | 0.05 | Series Filaments | | | Class-A Amp. | 90 | — 4.5 | 90 | 1.7 | 7.7 | 120000 | 2000 | —— | 10000 | 0.24 | |
| 6AB4 | Triode R.F. Amp. | B. | 5CE | 6.3 | 0.15 | 2.2 | 0.5 | 1.5 | Class-A Amp. | 250 | — 2 | —— | —— | 10 | —— | 5500 | 55 | —— | —— | Single unit 12AT7 |
| 6AG5 | Sharp Cut-off Pentode | B. | 7BD | 6.3 | 0.3 | —— | —— | —— | Class-A Amp. | 250 | 200* | 150 | 2.0 | 7.0 | 800000 | 5000 | —— | —— | —— | 6SH7GT |
| | | | | | | | | | | 100 | 100* | 100 | 1.6 | 5.5 | 300000 | 4750 | —— | —— | | |
| 6AH6 | Sharp Cut-off Pentode | B. | 7CC | 6.3 | 0.45 | 10 | 2 | 0.03 | Pentode Amp. | 300 | 160* | 150 | 2.5 | 10 | 500000 | 9000 | —— | —— | —— | 6AC7 |
| | | | | | | | | | Triode Amp.[7] | 150 | 160* | —— | —— | 12.5 | 3600 | 11000 | 40 | —— | —— | |
| 6AJ5 | Sharp Cut-off Pentode | B. | 7PM | 6.3 | 0.175 | —— | —— | —— | R.F. Amplifier | 28 | 200* | 28 | 1.2 | 3.0 | 90000 | 2750 | 250 | —— | —— | —— |
| | | | | | | | | | Class-AB Amp.[3] | 180 | — 7.5 | 75 | —— | —— | —— | —— | —— | 28000[6] | 1.0 | |
| 6AK5 | Sharp Cut-off Pentode | B. | 7BD | 6.3 | 0.175 | 4.3 | 2.1 | 0.03 | R.F. Amplifier | 180 | 200* | 120 | 2.4 | 7.7 | 690000 | 5100 | 3500 | —— | —— | —— |
| | | | | | | | | | | 150 | 330* | 140 | 2.2 | 7.0 | 420000 | 4300 | 1800 | —— | —— | |
| | | | | | | | | | | 120 | 200* | 120 | 2.5 | 7.5 | 340000 | 5000 | 1700 | —— | —— | |

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## TABLE XI—MINIATURE RECEIVING TUBES—*Continued*

| Type | Name | Base | Socket Connections[1] | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor[4] | Load Resistance Ohms | Power Output Watts | Prototype |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6AK6 | Power Amplifier Pentode | B. | 7BK | 6.3 | 0.15 | 3.6 | 4.2 | 0.12 | Class-A Amp. | 180 | — 9.0 | 180 | 2.5 | 15.0 | 200000 | 2300 | — | 10000 | 1.1 | — |
| 6AL5 | U.h.f. Twin Diode | B. | 6BT | 6.3 | 0.3 | — | — | — | Detector | Max. r.m.s. voltage—150. Max. d.c. output current—10 ma.[1] | | | | | | | | | | 6H6GT |
| 6AN5 | Power Amp. Pentode | B. | 7BD | 6.3 | 0.5 | 9.0 | 4.8 | 0.05 | Class-$A_1$ Amp. | 120 | — 6 | 120 | 12 | 35 | 12500 | 8000 | — | — | — | 6AG7 |
| 6AN6 | Twin Diode | B. | 7BJ | 6.3 | 0.2 | — | — | — | Detector | R.m.s. voltage per plate = 75 volts; d.c. output = 3.5 ma. with 25000 ohms and 8 μμfd. load; peak current per plate = 10 ma.; peak inverse voltage = 210. | | | | | | | | | | — |
| 6AQ5 | Beam Power Tetrode | B. | 7BZ | 6.3 | 0.45 | 7.6 | 6.0 | 0.35 | Class-$A_1$ Amp. | 180 | — 8.5 | 180 | 4.0[2] | 30[2] | 58000 | 3700 | 29[2] | 5500 | 2.0 | 6V6GT |
| | | | | | | | | | | 250 | —12.5 | 250 | 7.0[2] | 47[2] | 52000 | 4100 | 45[2] | 5000 | 4.5 | |
| 6AQ6 | Duodiode Hi-mu Triode | B. | 7BT | 6.3 | 0.15 | 1.7 | 1.5 | 1.80 | Class-A Triode | 250 | — 3.0 | — | — | 1.0 | 58000 | 1200 | 70 | — | — | 6T7G |
| | | | | | | | | | | 100 | — 1.0 | — | — | 0.8 | 61000 | 1150 | 70 | — | — | |
| 6AR5 | Pentode Power Amp. | B. | 6CC | 6.3 | 0.4 | — | — | — | Class-$A_1$ Amp. | 250 | —18 | 250 | 5.5[2] | 33[2] | 68000 | 2300 | — | 7600 | 3.4 | 6K6GT |
| | | | | | | | | | | 250 | —16.5 | 250 | 5.5[2] | 35[2] | 65000 | 2400 | — | 7000 | 3.2 | |
| 6AS5 | Beam Pentode | B. | 7CV | 6.3 | 0.8 | 12 | 6.2 | 0.6 | Class-$A_1$ Amp. | 150 | — 8.5 | 110 | 2/6.5 | 35/36 | — | 5600 | | 4500 | 2.2 | — |
| 6AS6 | Sharp Cut-off Pentode | B. | 7CM | 6.3 | 0.175 | 4.0 | 3.0 | 0.02 | Class-A Amp. | 120 | — 2 | 120 | 3.5 | 5.5 | — | 3500 | — | — | — | — |
| 6AT6 | Duplex Diode Triode | B. | 7BT | 6.3 | 0.3 | 2.3 | 1.1 | 2.10 | Class-A Amp. | 250 | — 3 | — | — | 1.0 | 58000 | 1200 | 70 | — | — | 6Q7GT |
| 6AU6 | Sharp Cut-off Pentode | B. | 7BK | 6.3 | 0.3 | 5.5 | 5.0 | .0035 | Class-A Amp. | 250 | — 1 | 150 | 4.3 | 10.8 | 2000000 | 5200 | — | — | — | 6SH7GT |
| 6AV6 | Duodiode Hi-mu Triode | B. | 7BT | 6.3 | 0.3 | — | — | — | Class-$A_1$ Amp. | 250 | — 2 | — | — | 1.2 | 62500 | 1600 | 100 | — | — | 6SQ7GT |
| 6BA6 | Remote Cut-off Pentode | B. | 7CC | 6.3 | 0.3 | 5.5 | 5.0 | .0035 | Class-A Amp. | 250 | 68* | 100 | 4.2 | 11 | 1500000 | 4400 | — | — | — | 6SG7GT |
| 6BA7 | Pentagrid Converter | B. | 8CT | 6.3 | 0.3 | 9.5 | 8.3 | — | Converter | 250 | — 1 | 100 | 10 | 3.8 | 1000000 | 3.5 | — | — | — | 6SB7Y |
| 6BD6 | Remote Cut-off Pentode | B. | 7CC | 6.3 | 0.3 | — | — | — | Class-A Amp. | 100 | — 1 | 100 | 5 | 13 | 120000 | 2350 | — | — | — | 6SK7GT |
| | | | | | | | | | | 250 | — 3 | 100 | 3.5 | 9 | 700000 | 2000 | — | — | — | |
| 6BE6 | Pentagrid Converter | B. | 7CH | 6.3 | 0.3 | Osc. Grid 50000 Ω | | | Converter | 250 | — 1.5 | 100 | 7.8 | 3.0 | 1000000 | 475 | — | — | — | 6SA7GT |
| 6BF6 | Duplex-Diode Triode | B. | 7BT | 6.3 | 0.3 | 1.8 | 1.1 | 2.0 | Class-$A_1$ Amp. | 250 | — 9 | — | — | 9.5 | 8500 | 1900 | 16 | 10000 | — | 6SR7GT |
| 6BH6 | Sharp Cut-off Pentode | B. | 7CM | 6.3 | 0.15 | 5.4 | 4.4 | 0.0035 | Class-$A_1$ Amp. | 250 | — 1 | 150 | 2.9 | 7.4 | 1400000 | 4600 | — | — | — | — |
| 6BJ6 | Remote Cut-off Pentode | B. | 7CM | 6.3 | 0.15 | 4.5 | 5.0 | .0035 | Class-$A_1$ Amp. | 250 | — 1 | 100 | 3.3 | 9.2 | 1300000 | 3800 | — | — | — | 6SS7GT |
| 6C4 | Triode Amplifier | B. | 6BG | 6.3 | 0.15 | 1.8 | 1.3 | 1.60 | Class-$A_1$ Amp. | 250 | — 8.5 | — | — | 10.5 | 7700 | 2200 | 17 | — | — | 6J5GT |
| 6J4 | U.h.f. Grounded-Grid R.F. Amplifier | B. | 7BQ | 6.3 | 0.4 | 5.5 | 0.24 | 4.0 | Grounded-Grid | 150 | 200* | — | — | 15.0 | 4500 | 12000 | 55 | — | — | — |
| | | | | | | | | | Class-$A_1$ Amp. | 100 | 100* | — | — | 10.0 | 5000 | 11000 | 55 | — | — | |
| 6J6 | Twin Triode | B. | 7BF | 6.3 | 0.45 | 2.2 | 0.4 | 1.6 | Class-$A_1$ Amp. Mixer, Oscillator | 100 | 50* | — | — | 8.5 | 7100 | 5300 | 38 | — | — | — |
| 6N4 | U.h.f. Triode Amplifier | B. | 7CA | 6.3 | 0.2 | 3.0 | 1.6 | 1.10 | Class-A Amp. | 180 | — 3.5 | — | — | 12.0 | — | 6000 | 32 | — | — | — |
| 6T8 | Triple-Diode Triode | B. | 9E | 6.3 | 0.45 | 1.5 | 1.1 | 2.4 | Class-$A_1$ Amp. | 250 | — 3 | — | — | 1.0 | 5800 | 1200 | 70 | — | — | — |
| | | | | | | | | | | 100 | — 1 | — | — | 0.8 | 5400 | 1300 | 70 | — | — | |
| 12AL5 | Twin Diode | B. | 6BT | 12.6 | 0.15 | 2.5 | — | — | Detector | R.m.s. voltage per plate = 117; d.c. output = 9 ma. per plate; peak ma. per plate = 54; peak inverse voltage = 330. | | | | | | | | | | 12H6GT |
| 12AT6 | Duplex Diode Triode | B. | 7BT | 12.6 | 0.15 | 2.3 | 1.1 | 2.10 | Class-A Amp. | 250 | — 3.0 | — | — | 1.0 | 58000 | 1200 | 70 | — | — | 12Q7GT |
| 12AT7 | Double Triode | B. | 9A | 6.3 | 0.3 | 2.5[7] | 0.45[7] | 1.45[7] | Class-$A_1$ Amp. | 250 | — 2 | — | — | 10 | 10000 | 5500 | 55 | — | — | — |
| | | | | 12.6 | 0.15 | 2.5[8] | 0.35[8] | 1.45[8] | Each Unit | 180 | — 1 | — | — | 11 | 9400 | 6600 | 62 | — | — | |
| 12AU6 | Sharp Cut-off Pentode | B. | 7CC | 12.6 | 0.15 | 5.5 | 5.0 | .0035 | Class-$A_1$ Amp. | 250 | — 1.0 | 150 | 4.3 | 10.8 | 1 meg. | 5200 | — | — | — | 12SH7GT |
| 12AU7 | Twin-Triode Amplifier | B. | 9A | 6.3 | 0.3 | 1.6[7] | 0.5[7] | 1.5[7] | Class-$A_1$ Amp. | 250 | — 8.5 | — | — | 10.5 | 7700 | 2200 | 17 | — | — | 12SN7GT |
| | | | | 12.6 | 0.15 | 1.6[8] | 0.35[8] | 1.5[8] | | | | | | | | | | | | |
| 12AV6 | Duodiode Hi-mu Triode | B. | 7BT | 12.6 | 0.15 | — | — | — | Class-$A_1$ Amp. | 250 | — 2 | — | — | 1.2 | 62500 | 1600 | 100 | — | — | — |
| 12AW6 | Sharp Cut-off Pentode | B. | 7CM | 12.6 | 0.15 | 6.5 | 1.5 | 0.025 | Pentode Amp. | 250 | 200* | 150 | 2.0 | 7.0 | 800000 | 5000 | — | — | — | — |
| | | | | | | | | | Triode Amp.[9] | 250 | 825* | — | — | 5.5 | 11000 | 3800 | 42 | — | — | |
| 12AW7 | Sharp Cut-off Pentode | B. | 7CM | 12.6 | 0.15 | 6.5 | 1.5 | 0.025 | Class-$A_1$ Amp. | 250 | 200* | 150 | 2.0 | 7.0 | 0.8 meg. | 5000 | — | — | — | — |
| 12AX7 | Double Triode | B. | 9A | 12.6 | 0.15 | 1.6[7] | 0.46[7] | 1.7[7] | Class-$A_1$ Amp. | 250 | — 2 | — | — | 1.2[1] | 62500 | 1600 | 100 | — | — | — |
| | | | | 6.3 | 0.3 | 1.6[8] | 0.34[8] | 1.7[8] | | 100 | — 1 | — | — | 0.5[1] | 8000 | 1250 | 100 | — | — | |
| 12AY7 | Dual Triode | B. | 9A | 12.6 | 0.15 | 1.3 | 0.6 | 1.3 | Class-A Amp. | 250 | — 4 | — | — | 3 | — | 1750 | 40 | — | — | — |
| | | | | 6.3 | 0.3 | | | | Lo-Level Amp. | 150 | 2700* | Plate resistor = 20000 Ω. Grid resistor = 0.1 Meg. V.G. = 12.5 | | | | | | | | |
| 12BA6 | Remote Cut-off Pentode | B. | 7CC | 12.6 | 0.15 | 5.5 | 5.0 | .0035 | Class-A Amp. | 250 | 68* | 100 | 4.2 | 11.0 | 1500000 | 4400 | — | — | — | 12SG7G |



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## TABLE XI — MINIATURE RECEIVING TUBES — *Continued*

| Type | Name | Base | Socket Connections[1] | Fil. or Heater | | Capacitance μμfd. | | | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Prototype |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Volts | Amp. | In | Out | Plate-Grid | | | | | | | | | | | | |
| 12BA7 | Pentagrid Converter | B. | 8CT | 12.6 | 0.15 | 9.5 | 8.3 | —— | Converter | 250 | — 1 | 100 | 10 | 3.8 | 1000000 | 3.5 | —— | —— | —— | —— |
| 12BD6 | Remote Cut-off Pentode | B. | 7CC | 12.6 | 0.15 | 4.3 | 5.0 | .004 | Class-A Amp. | 250 | — 3 | 100 | 3.5 | 9.0 | 700000 | 2000 | —— | —— | —— | 12SK7GT |
| 12BE6 | Pentagrid Converter | B. | 7CH | 12.6 | 0.15 | Osc. Grid 50000 Ω | | | Converter | 250 | — 1.5 | 100 | 7.8 | 3.0 | 1000000 | 475 | —— | —— | —— | 12SA7GT |
| 12BF6 | Duodiode Triode | B. | 7BT | 12.6 | 0.15 | 1.8 | 1.1 | 2.00 | Class-A Amp. | 250 | — 9 | —— | —— | 9.5 | 8500 | 1900 | 16 | —— | —— | 12SR7GT |
| 19J6 | Twin Triode | B. | 7BF | 18.9 | 0.15 | 2.0 | 0.4 | 1.5 | Class-$A_1$ Amp. | 100 | 50* | —— | —— | 8.5[1] | 7100 | 5300 | 38 | —— | —— | —— |
| 19T8 | Triple-Diode Triode | B. | 9E | 18.9 | 0.15 | 1.5 | 1.1 | 2.4 | Class-$A_1$ Amp. | 250 | — 3 | —— | —— | 1.0 | 5800 | 1200 | 70 | —— | —— | —— |
| 26A6 | Remote Cut-off Pentode | B. | 7BK | 26.5 | 0.07 | 6.0 | 5.0 | .0035 | Class-$A_1$ Amp. | 250 | 125* | 100 | 4 | 10.5 | 1000000 | 4000 | —— | —— | —— | —— |
| 26C6 | Duplex-Diode Triode | B. | 7BT | 26.5 | 0.07 | 1.8 | 1.4 | 2 | Class-$A_1$ Amp. | 250 | — 9 | —— | —— | 9.5 | 8500 | 1900 | 16 | —— | —— | —— |
| 26D6 | Pentagrid Converter | B. | 7CH | 26.5 | 0.07 | Osc. Grid 20000 Ω | | | Converter | 250 | — 1.5 | 100 | 7.8 | 3.0 | 1000000 | 475 | —— | —— | —— | —— |
| 35B5 | Beam Power Amplifier | B. | 7BZ | 35 | 0.15 | 11 | 6.5 | 0.4 | Class-$A_1$ Amp. | 110 | — 7.5 | 110 | 7[2] | 41[2] | —— | 5800 | 40[2] | 2500 | 1.5 | 35L6GT |
| 35C5 | Beam Power Amplifier | B. | 7CV | 35 | 0.15 | 12 | 6.2 | 0.57 | Class-$A_1$ Amp. | 110 | — 7.5 | 110 | 3/7 | 40/41 | —— | 5800 | | 2500 | 1.5 | —— |
| 50B5 | Beam Power Amplifier | B. | 7BZ | 50 | 0.15 | 13 | 6.5 | 0.50 | Class-A Amp. | 110 | — 7.5 | 110 | 4.0 | 49.0 | 14000 | 7500 | —— | 3000 | 1.9 | 50L6GT |
| 50C5 | Beam Power Amplifier | B. | 7CV | 50 | 0.15 | —— | —— | —— | Class-$A_1$ Amp. | 110 | — 7.5 | 110 | 4/8.5 | 49/50 | 10000 | 7500 | —— | 2500 | 1.9 | —— |
| 5590 | Pentode | B. | 7BD | 6.3 | 0.15 | 3.4 | 2.9 | 0.01 | Class-$A_1$ Amp. | 90 | 820* | 90 | 1.4 | 3.9 | 300000 | 2000 | —— | —— | —— | —— |
| 5591 | R.F. Pentode | B. | 7BD | 6.3 | 0.15 | 3.9 | 2.85 | 0.01 | Class-$A_1$ Amp. | 180 | 200* | 120 | 2.4 | 1.7 | 690000 | 5100 | 3500 | —— | —— | —— |
| 5654 | Sharp Cut-off Pentode | B. | 7BD | 6.3 | 0.175 | 4 | 2.9 | 0.02 | Class-$A_1$ Amp. | 120 | 200* | 120 | 2.5 | 7.5 | 340000 | 5000 | —— | —— | —— | —— |
| 5687 | Dual Triode | B. | 9H | 12.6 | 0.45 | 4 | 0.45 | 3.1 | Class-A Amp. | 250 | 12.5 | —— | —— | 16 | 4000 | 4100 | 16.5 | —— | —— | —— |
| | | | | 6.3 | 0.9 | | | | | 120 | 2 | —— | —— | 34 | 2000 | 10000 | 20 | —— | —— | |
| 5722 | Noiso Generating Diode | B. | 5CB | 2/5.5 | 1.6 | —— | 1.5 | —— | Noise Generator | 200 | —— | —— | —— | 35 | —— | —— | —— | —— | —— | —— |
| 9001 | Sharp Cut-off Pentode | B. | 7PM | 6.3 | 0.15 | 3.6 | 3.0 | 0.01 | Class-A Amp. | 250 | 3.0 | 100 | 0.7 | 2.0 | 1 meg. | 1400 | —— | —— | —— | —— |
| | | | | | | | | | Mixer | 250 | — 5.0 | 100 | Osc. peak voltage 4 volts | | | 550 | —— | —— | —— | |
| 9002 | Triode Detector, Amplifier, Oscillator | B. | 7TM | 6.3 | 0.15 | 1.2 | 1.1 | 1.40 | Class-A Amp. | 250 | 7.0 | —— | —— | 6.3 | 11400 | 2200 | 25 | —— | —— | —— |
| | | | | | | | | | | 90 | 2.5 | —— | —— | 2.5 | 14700 | 1700 | 25 | —— | —— | |
| 9003 | Remote Cut-off Pentode | B. | 7PM | 6.3 | 0.15 | 3.6 | 3.0 | 0.01 | Class-A Amp. | 250 | — 3.0 | 100 | 2.7 | 6.7 | 700000 | 1800 | —— | —— | —— | —— |
| | | | | | | | | | Mixer | 250 | 10.0 | 100 | Osc. peak voltage 9 volts | | | 600 | —— | —— | —— | |
| 9006 | U.h.f. Diode | B. | 6BH | 6.3 | 0.15 | —— | —— | —— | Detector | Max. a.c. voltage—270. Max. d.c. output current—5 ma. | | | | | | | | | | —— |

* Cathode resistor—ohms.

[1] Per Plate.
[2] Maximum-signal current for full-power output.
[3] Values are for two tubes in push-pull.
[4] Also no-signal plate ma. when so indicated.
[5] No signal plate ma.
[6] Effective plate-to-plate.
[7] Triode No. 1.
[8] Triode No. 2.
[9] Grid No. 2 tied to plate and No. 3 to cathode.

## TABLE XII — SUB-MINIATURE TUBES

| Type | Name | Base | Socket Connections | Fil. or Heater | | Capacitance μμfd. | | | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Volts | Amp. | In | Out | Plate-Grid | | | | | | | | | | | | |
| 1AC5 | Power Pentode | Bs. | Fig. 14 | 1.25 | 0.04 | —— | —— | —— | Class-$A_1$ Amp. | 67.5 | —4.5 | 67.5 | 0.4 | 2.0 | 150000 | 750 | —— | 25000 | 0.05 | 1AC5 |
| 1AD5 | Sharp Cut-off Pentode | Bs. | Fig. 16 | 1.25 | 0.04 | 1.8 | 2.8 | 0.01 | Class-$A_1$ Amp. | 67.5 | 0 | 67.5 | 0.75 | 1.85 | 700000 | 735 | —— | —— | —— | 1AD5 |
| 1C8 | Heptode | — | —— | 1.25 | 0.04 | 6.5 | 4.0 | 0.25 | Converter | 30 | 0 | 30 | 0.75 | 0.32 | 300000 | 100 | —— | —— | —— | 1C8 |
| 1E8 | Pentagrid Converter | Bs. | Fig. 27 | 1.25 | 0.04 | 6 | —— | —— | Converter | 67.5 | 0 | 67.5 | 1.5 | 1.0 | —— | 150 | —— | —— | —— | 1E8 |
| 1T6 | Diode-Pentode | Bs. | Fig. 28 | 1.25 | 0.04 | —— | —— | —— | Class-$A_1$ Amp. | 67.5 | 0 | 67.5 | 0.4 | 1.6 | 400000 | 600 | —— | —— | —— | 1T6 |
| 1V5 | Audio Pentode | 1 | 2 | 1.25 | 0.04 | —— | —— | —— | Class-$A_1$ Amp. | 67.5 | —4.5 | 67.5 | 0.4 | 2.0 | 150000 | 750 | —— | 25000 | 0.05 | 1V5 |
| 1W5 | Sharp Cut-off Pentode | 1 | 2 | 1.25 | 0.04 | 2.3 | 3.5 | 0.01 | Class-$A_1$ Amp. | 67.5 | 0 | 67.5 | 0.75 | 1.85 | 700000 | 735 | —— | —— | —— | 1W5 |
| 2E31 | R.F. Pentode | 1 | 2 | 1.25 | 0.05 | | | | Class-$A_1$ Amp. | 22.5 | 0 | 22.5 | 0.3 | 0.4 | —— | 500 | —— | —— | —— | 2E31 |
| 2E32 | R.F. Pentode | 1 | 2 | 1.25 | 0.05 | | | | Class-A Amp. | 22.5 | 0 | 22.5 | 0.3 | 0.4 | 350000 | 500 | —— | —— | —— | 2E32 |
| 2E35 | Audio Pentode | 1 | 2 | 1.25 | 0.03 | | | | Class-$A_1$ Amp. | 22.5 | 0 | 22.5 | 0.07 | 0.27 | —— | 385 | —— | —— | 0.0012 | 2E35 |
| 2E36 | Audio Pentode | 1 | 2 | 1.25 | 0.03 | | | | Class-$A_1$ Amp. | 22.5 | 0 | 22.5 | 0.07 | 0.27 | 220000 | 385 | —— | 150000 | 0.0012 | 2E36 |
| | | | | | | | | | | 45 | —1.25 | 45 | 0.11 | 0.45 | 250000 | 500 | —— | 100000 | 0.006 | |
| 2E41 | Diode Pentode | 1 | 2 | 1.25 | 0.03 | —— | —— | —— | Detector Amp. | 22.5 | 0 | 22.5 | 0.12 | 0.35 | —— | —— | —— | —— | —— | 2E41 |
| 2E42 | Diode Pentode | 1 | 2 | 1.25 | 0.03 | | | | Detector Amp. | 22.5 | 0 | 22.5 | 0.12 | 0.35 | 250000 | 375 | —— | 1 meg. | —— | 2E42 |

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## TABLE XII — SUB-MINIATURE TUBES — *Continued*

| Type | Name | Base | Socket Connections | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2G21 | Triode Heptode | 1 | 2 | 1.25 | 0.05 | — | — | — | Converter | 22.5 | — | 22.5 | 0.2 | 0.3 | — | 75 | — | — | | 2G21 |
| 2G22 | Converter | 1 | 2 | 1.25 | 0.05 | | | | Converter | 22.5 | 0 | 22.5 | 0.3 | 0.2 | 500000 | 60 | — | — | — | 2G22 |
| 6K4 | Triode | 1 | 2 | 6.3 | 0.15 | 2.4 | 0.8 | 2.4 | Class $A_1$ Amp. | 200 | 680* | — | — | 11.5 | 4650 | 3450 | 16 | — | — | 6K4 |
| 1247 | Diode | 1 | 2 | 0.7 | 0.065 | — | — | — | R.F. Probe | | | Max. a.c. volts—300 r.m.s. | | D.C. plate current—0.4 Ma. | | | | | | 1247 |
| CK501 | Pentode Voltage Amplifier | —[1] | 2 | 1.25 | 0.033 | — | — | — | Class-A Amp. | 30 | 0 | 30 | 0.06 | 0.3 | 1000000 | 325 | — | — | — | CK501 |
| | | | | | | | | | | 45 | −1.25 | 45 | 0.055 | 0.28 | 1500000 | 300 | | | | |
| CK502 | Pentode Output Amplifier | —[1] | 2 | 1.25 | 0.033 | — | — | — | Class-A Amp. | 30 | 0 | 30 | 0.13 | 0.55 | 500000 | 400 | — | 60000 | 0.003 | CK502 |
| CK503 | Pentode Output Amplifier | —[1] | 2 | 1.25 | 0.033 | — | — | — | Class-A Amp. | 30 | 0 | 30 | 0.33 | 1.5 | 150000 | 600 | — | 20000 | 0.006 | CK503 |
| CK504 | Pentode Output Amplifier | —[1] | 2 | 1.25 | 0.033 | — | — | — | Class-A Amp. | 30 | −1.25 | 30 | 0.09 | 0.4 | 500000 | 350 | — | 60000 | 0.003 | CK504 |
| CK505 | Pentode Voltage Amplifier | —[1] | 2 | 0.625 | 0.05 | — | — | — | Class-A Amp. | 30 | 0 | 30 | 0.07 | 0.17 | 1100000 | 140 | — | — | — | CK505 |
| | | | | | | | | | | 45 | −1.25 | 45 | 0.08 | 0.2 | 2000000 | 150 | | | | |
| CK506 | Pentode Output Amplifier | —[1] | 2 | 1.25 | 0.05 | — | — | — | Class-$A_1$ Amp. | 45 | −4.5 | 45 | 0.4 | 1.25 | 120000 | 500 | — | 30000 | 0.025 | CK506 |
| CK507 | Pentode Output Amplifier | —[1] | 2 | 1.25 | 0.05 | — | — | — | Class-$A_1$ Amp. | 45 | −2.5 | 45 | 0.21 | 0.6 | 360000 | 500 | — | 50000 | 0.010 | CK507 |
| CK509 | Triode Voltage Amplifier | —[1] | 2 | 0.625 | 0.03 | — | — | — | Class-A Amp. | 45 | 0 | — | — | 0.15 | 150000 | 160 | 16 | 1000000 | — | CK509 |
| CK510 | Dual Space-Charge Tetrode | —[1] | 2 | 0.625* | 0.05 | — | — | — | Class-A Amp. | 45 | 0 | 0.2 | 200 μa | 60 μa | 500000 | 65 | 32.5 | — | — | CK510 |
| CK512 | Low Microphonic Pentode | 1 | 2 | 0.625 | 0.02 | — | — | — | Voltage Amp. | 22.5 | 0 | 22.5 | 0.04 | 0.125 | — | 160 | — | — | — | CK412 |
| CK515BX | Triode Voltage Amplifier | —[1] | 2 | 0.625 | 0.03 | — | — | — | Class-A Amp. | 45 | 0 | — | — | 0.15 | — | 160 | 24 | 1000000 | — | CK515BX |
| CK520AX | Audio Pentode | 1 | 2 | 0.625 | 0.05 | — | — | — | Class-$A_1$ Amp. | 45 | −2.5 | 45 | 0.07 | 0.24 | — | 180 | — | — | 0.0045 | CK520AX |
| CK521AX | Audio Pentode | 1 | 2 | 1.25 | 0.05 | — | — | — | Class-$A_1$ Amp. | 22.5 | −3 | 22.5 | 0.22 | 0.8 | — | 400 | — | — | 0.006 | CK521AX |
| CK522AX | Audio Pentode | 1 | 2 | 1.25 | 0.02 | — | — | — | Class-$A_1$ Amp. | 22.5 | 0 | 22.5 | 0.08 | 0.3 | — | 450 | — | — | 0.0012 | CK522AX |
| CK523AX | Pentode Output Amp. | 1 | — | 1.25 | 0.03 | — | — | — | Class-A Amp. | 22.5 | −1.2 | 22.5 | 0.075 | 0.3 | — | 360 | — | — | 0.0025 | CK523AX |
| CK524AX | Pentode Output Amp. | 1 | — | 1.25 | 0.03 | — | — | — | Class-A Amp. | 15 | −1.75 | 15 | 0.125 | 0.45 | — | 300 | — | — | 0.0022 | CK524AX |
| CK525AX | Pentode Output Amp. | 1 | — | 1.25 | 0.2 | — | — | — | Class-A Amp. | 22.5 | −1.2 | 22.5 | 0.06 | 0.25 | — | 325 | — | — | 0.0022 | CK525AX |
| CK526AX | Pentode Output Amp. | 1 | — | 1.25 | 0.2 | — | — | — | Class-A Amp. | 22.5 | −1.5 | 22.5 | 0.12 | 0.45 | — | 400 | — | — | 0.004 | CK526AX |
| CK527AX | Pentode Output Amp. | 1 | — | 1.25 | 0.015 | — | — | — | Class-A Amp. | 22.5 | 0 | 22.5 | 0.025 | 0.1 | — | 75 | — | — | 0.0007 | CK527AX |
| CK529AX | Shielded Output Pentode | 1 | — | 1.25 | 0.02 | — | — | — | Class-A Amp. | 15 | −1.5 | 15 | 0.05 | 0.2 | — | 275 | — | — | 0.0012 | CK529AX |
| CK551AXA | Diode Pentode | 1 | 2 | 1.25 | 0.03 | — | — | — | Detector-Amp. | 22.5 | 0 | 22.5 | 0.04 | 0.17 | — | 235 | — | — | — | CK551AXA |
| CK553AXA | R.F. Pentode | 1 | 2 | 1.25 | 0.05 | — | — | — | Class-$A_1$ Amp. | 22.5 | 0 | 22.5 | 0.13 | 0.42 | — | 550 | — | — | — | CK553AXA |
| CK556AX | U.h.f. Triode | 1 | 2 | 1.25 | 0.125 | — | — | — | R.F. Oscillator | 135 | −5 | — | — | 4.0 | — | 1600 | — | — | — | CK556AX |
| CK568AX | U.h.f. Triode | 1 | 2 | 1.25 | 0.07 | — | — | — | R.F. Oscillator | 135 | −6 | — | — | 1.9 | — | 650 | — | — | — | CK568AX |
| CK569AX | R.F. Pentode | 1 | 2 | 1.25 | 0.05 | — | — | — | Class-$A_1$ Amp. | 67.5 | 0 | 67.5 | 0.48 | 1.8 | — | 1100 | — | — | — | CK569AX |
| CK605CX | Sharp Cut-off Pentode | 1 | — | 6.3 | 0.2 | — | — | — | Class-A Amp. | 120 | −2 | 120 | 2.5 | 7.5 | — | 5000 | — | — | — | CK605CX |
| CK606BX | Single Diode | 1 | 2 | 6.3 | 0.15 | — | — | — | Detector | 150 a.c. | — | — | — | 9.0 d.c. | — | — | — | — | — | CK606BX |
| CK608CX | U.h.f. Triode | 1 | 2 | 6.3 | 0.2 | — | — | — | 500-Mc. Osc. | 120 | −2 | — | — | 9.0 | — | 5000 | — | — | 0.75 | CK608CX |
| CK619CX | Hi-Mu Triode | 1 | 2 | 6.3 | 0.2 | — | — | — | Class-$A_1$ Amp. | 250 | −2 | — | — | 4.0 | — | 4000 | — | — | — | CK619CX |
| CK624CX | Sharp Cut-off Pentode | 1 | — | 6.3 | 0.2 | — | — | — | Class-A Amp. | 120 | −2 | 120 | 3.5 | 5.2 | — | 3000 | — | — | — | CK624CX |
| CK650AX | Sharp Cut-off Pentode | 1 | 2 | 6.3 | 0.2 | — | — | — | Class-$A_1$ Amp. | 120 | −2 | 120 | 2.5 | 7.5 | — | 5000 | — | — | — | CK650AX |
| CK5672 | Pentode Output Amp. | 1 | — | 1.25 | 0.05 | — | — | — | Class-A Amp. | 67.5 | −6.25 | 67.5 | 1.0 | 2.75 | — | 625 | — | — | 0.06 | CK5672 |
| HY113 HY123 | Triode Amplifier | —[1] | 5K | 1.4 | 0.07 | — | — | — | Class-A Amp. | 45 | −4.5 | — | — | 0.4 | 25000 | 250 | 6.3 | 40000 | 0.0065 | HY113 HY123 |
| HY115 HY145 | Pentode Voltage Amplifier | —[1] | 5K | 1.4 | 0.07 | — | — | — | Class-A Amp. | 45<br>90 | −1.5<br>−1.5 | 22.5<br>45 | 0.008<br>0.1 | 0.03<br>0.48 | 5200000<br>1300000 | 58<br>270 | 300<br>370 | — | — | HY115 HY145 |
| HY125 HY155 | Pentode Power Amplifier | —[1] | 5K | 1.4 | 0.07 | — | — | — | Class-A Amp. | 45<br>90 | −3.0<br>−7.5 | 45<br>90 | 0.2<br>0.5 | 0.9<br>2.6 | 825000<br>420000 | 310<br>450 | 255<br>190 | 50000<br>28000 | 0.0115<br>0.09 | HY125 HY155 |
| M54 | Tetrode Power Amplifier | 1 | 2 | 0.625 | 0.04 | — | — | — | Class-A Amp. | 30 | 0 | 30 | 0.06 | 0.5 | 130000 | 200 | 26 | 35000 | 0.005 | M54 |
| M64 | Tetrode Voltage Amplifier | 1 | 2 | 0.625 | 0.02 | — | — | — | Class-A Amp. | 30 | 0 | — | — | 0.03 | 200000 | 110 | 25 | — | — | M64 |
| M74 | Tetrode Voltage Amplifier | 1 | 2 | 0.625 | 0.02 | — | — | — | Class-A Amp. | 30 | 0 | 7.0 | 0.01 | 0.02 | 500000 | 125 | 70 | — | — | M74 |
| RK61 | Gas Triode | 1 | 2 | 1.4 | 0.05 | — | — | — | Radio Control | 45 | — | — | — | 1.5 | — | — | — | — | — | RK61 |
| SD917A 5637 | Triode | 1 | 2 | 6.3 | 0.15 | 2.6 | 0.7 | 1.4 | Class-$A_1$ Amp. | 100 | 820* | — | — | 1.4 | 26000 | 2700 | 70 | — | — | SD917A 5637 |

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## TABLE XII — SUB-MINIATURE TUBES — *Continued*

| Type | Name | Base | Socket Connections | Fil. or Heater Volts | Fil. or Heater Amp. | Capacitance μμfd. In | Capacitance μμfd. Out | Capacitance μμfd. Plate-Grid | Use | Plate Supply Volts | Grid Bias | Screen Volts | Screen Current Ma. | Plate Current Ma. | Plate Resistance Ohms | Transconductance Micromhos | Amp. Factor | Load Resistance Ohms | Power Output Watts | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SD828A 5638 | Audio Pentode | 1 | 2 | 6.3 | 0.15 | 4.0 | 3.0 | 0.22 | Class-$A_1$ Amp. | 100 | 270* | 100 | 1.25 | 4.8 | 150000 | 3300 | — | — | — | SD828A 5638 |
| SD828E 5634 | Sharp Cut-off Pentode | 4 | — | 6.3 | 0.15 | 4.4 | 2.8 | 0.01 | Class-$A_1$ Amp. | 100 | 150* | 100 | 2.5 | 6.5 | 240000 | 3500 | — | — | — | SD828E 5634 |
| SN944 5633 | Remote Cut-off Pentode | 1 | — | 6.3 | 0.15 | 4.0 | 2.8 | 0.01 | Class-$A_1$ Amp. | 100 | 150* | 100 | 2.8 | 7.0 | 200000 | 3400 | — | — | — | SN944 5633 |
| SN946 | Diode | 1 | 2 | 6.3 | 0.15 | 1.8 | — | — | Rectifier | 150 | — | — | — | 9.0 | — | — | — | — | — | SN946 |
| SN947D 5640 | Audio Beam Pentode | 1 | 2 | 6.3 | 0.45 | — | — | — | Class-$A_1$ Amp. | 100 | −9 | 100 | 2.2 | 31.0 | 15000 | 5000 | — | 3000 | 1.25 | SN947C 5640 |
| SN948C | Voltage Regulator | 1 | — | — | — | — | — | — | Regulator | Operating voltage = 95; Max. current = 25 Ma. | | | | | | | | | | SN948C |
| SN953D | Power Pentode | 1 | — | 6.3 | 0.15 | 9.5 | 3.8 | 0.2 | Class-A Amp. | 150 | 100* | 100 | 4/7.5 | 21/20 | 50000 | 9000 | — | 9000 | 1.0 | SN953D |
| SN954 5641 | Half-Wave Rectifier | 1 | 2 | 6.3 | 0.45 | — | — | — | Rectifier | 300 | — | — | — | 45.0 | — | — | — | — | — | SN954 5641 |
| SN955B | Dual Triode | 1 | 2 | 6.3 | 0.45 | 2.8 | 1.0 | 1.3 | Class-$A_1$ Amp. [5] | 100 | 100* | — | — | 5.5 | 8000 | 4250 | 34 | — | — | SN955B |
| SN956B 5642 | H.V. Half-Wave Rectifier | 4 | — | 1.25 | 0.14 | — | — | — | H.V. Rectifier | Peak inverse V. = 10000 Max. Average Ip = 2 Ma. Peak Ip = 23 Ma. | | | | | | | | | | SN956B 5642 |
| SN957A 5645 | Triode | 1 | 2 | 6.3 | 0.15 | 2.0 | 1.0 | 1.8 | Class-$A_1$ Amp. | 100 | 560* | — | — | 5.0 | 7400 | 2700 | 20 | — | — | SN957A 5645 |
| SN1006 | Triode | 1 | 2 | 6.3 | 0.15 | | | | Class-$A_1$ Amp. | 100 | 820* | — | — | 1.4 | 29000 | 2400 | 70 | — | — | SN1006 |
| SN1007B | Mixer | 4 | — | 6.3 | 0.15 | 5.0 | 2.8 | 0.003 | Mixer | 100 | 150* | 100 | 5.0 | 4.0 | 230000 | 900 | — | — | — | SN1007B |

* Cathode resistor ohms. [1] No base; tinned wire leads. [2] Leads identified on tube. [3] No screen connection. [4] Double-ended type. [5] Values per triode.

## TABLE XIII—CONTROL AND REGULATOR TUBES

| Type | Name | Base | Socket Connections | Cathode | Fil. or Heater Volts | Fil. or Heater Amp. | Use | Peak Anode Voltage | Max. Anode Ma. | Minimum Supply Voltage | Operating Voltage | Operating Ma. | Grid Resistor | Tube Voltage Drop | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0A2 | Voltage Regulator | 7-pin B. | 5BO | Cold | — | — | Voltage Regulator | — | — | 185 | 150 | 5–30 | — | — | 0A2 |
| OA5 | Gas Pentode | 7-pin B. | Fig. 33 | Cold | — | — | Relay or Trigger | Plate −750 V., Screen −90 V., Grid −3 V., Pulse −85 V. | | | | | | | OA5 |
| 0B2 | Voltage Regulator | 7-pin B. | 5BO | Cold | — | — | Voltage Regulator | — | — | 133 | 108 | 5–30 | — | — | 0B2 |
| 0A4G 1267 | Gas Triode Starter-Anode Type | 6-pin O. | 4V 4V | Cold | — | — | Cold-Cathode Starter-Anode Relay Tube | With 105–120-volt a.c. anode supply, peak starter-anode a.c. voltage is 70, peak r.f. voltage 55. Peak d.c. ma = 100. Average d.c. ma = 25. | | | | | | | 0A4G 1267 |
| 1B47 | Voltage Regulator | 7-pin B. | — | — | — | — | Voltage Regulator | — | — | 225 | 82 | 1–2 | — | — | 1B47 |
| 1C21 | Gas Triode Glow-Discharge Type | 6-pin O. | 4V | Cold | — | — | Relay Tube | 125–145 | 25 | 66 [6] | — | — | — | 73 | 1C21 |
| | | | | | | | Voltage Regulator | | 0.1 [6] | 180 [4] | | | | 55 | |
| 2A4G | Gas Triode Grid Type | 7-pin O. | 5S | Fil. | 2.5 | 2.5 | Control Tube | 200 | 100 | — | — | — | — | 15 | 2A4G |
| 6Q5G | Gas Triode Grid Type | 8-pin O. | 6Q | Htr. | 6.3 | 0.6 | Sweep Circuit Oscillator | 300 | 300 | — | — | 1.0 | 0.1–10 [7] | 19 | 6Q5G |
| 2B4 | | 5-pin M. | 5A | Htr. | 2.5 | 1.4 | | | | | | | | | 2B4 |
| 2C4 | Gas Triode | 7-pin B. | 5AS | Fil. | 2.5 | 0.65 | Control Tube | Plate volts = 350; Grid volts = −50; Avg. Ma. = 5; Peak Ma. = 20; Voltage drop = 16. | | | | | | | 2C4 |
| 2D21 | Gas Tetrode | 7-pin B. | 7BN | Htr. | 6.3 | 0.6 | Grid-Controlled Rectifier | 650 | 500 | — | 650 | 100 | 0.1–10 [7] | 8 | 2D21 |
| | | | | | | | Relay Tube | 400 | — | — | — | — | 1.0 [7] | — | |
| 3C23 | Gas and Mercury Vapor Grid Type | 4-pin M. | 3G | Fil. | 2.5 | 7.0 | Grid-Controlled Rectifier | 1000 | 6000 | — | 500 | 1500 | −4.5 [4] | 15 | 3C23 |
| | | | | | | | | | | — | 100 | 1500 | −2.5 [4] | 15 | |
| 6D4 | Gas Triode | 7-pin B. | 5AY | Htr. | 6.3 | 0.25 | Control Tube | Plate volts = 350; Grid volts = −50; Avg. Ma. = 25; Peak Ma. = 100; Voltage drop = 16. | | | | | | | 6D4 |
| 17 | Mercury Vapor Triode | 4-pin M. | 3G | Fil. | 2.5 | 5.0 | Grid-Controlled Rectifier | 7500 [5] | 2000 | — | — | 500 | 200–3000 | — | 17 |
| | | | | | | | | 2500 | | −5 [3] | 1000 | 250 | — | 10–24 | |
| 874 | Voltage Regulator | 4-pin M. | 4S | — | — | — | Voltage Regulator | — | — | 125 | 90 | 10–50 | — | — | 874 |
| 876 | Current Regulator | Mogul | — | — | — | — | Current Regulator | — | — | — | 40–60 | 1.7 | — | — | 876 |
| 884 | Gas Triode Grid Type | 6-pin O. | 6Q | Htr. | 6.3 | 0.6 | Sweep Circuit Oscillator | 300 | 300 | — | — | 2 | 25000 | — | 884 |
| | | | | | | | Grid-Controlled Rectifier | 350 | 300 | — | — | 75 | 25000 | — | |
| 885 | Gas Triode Grid Type | 5-pin S. | 5A | Htr. | 2.5 | 1.4 | Same as Type 884 | Characteristics same as Type 884 | | | | | | | 885 |

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## TABLE XIII—CONTROL AND REGULATOR TUBES

| Type | Name | Base | Socket Connections | Cathode | Fil. or Heater Volts | Fil. or Heater Amp. | Use | Peak Anode Voltage | Max. Anode Ma. | Minimum Supply Voltage | Operating Voltage | Operating Ma. | Grid Resistor | Tube Voltage Drop | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 886 | Current Regulator | Magul | — | — | — | — | Current Regulator | — | — | — | 40–60 | 2.05 | — | — | 886 |
| 967 | Mercury Vapor Triode | 4-pin M. | 3G | Fil. | 2.5 | 5.0 | Grid-Controlled Rectifier | 2500 | 500 | −5 [3] | — | — | — | 10–24 | 967 |
| 991 | Voltage Regulator | Bayonet | — | — | — | — | Voltage Regulator | — | — | 87 | 55–60 | 2.0 | — | — | 991 |
| 1265 | Voltage Regulator | 6-pin O. | 4AJ | Cold | — | — | Voltage Regulator | — | — | 130 | 90 | 5–30 | — | — | 1265 |
| 1266 | Voltage Regulator | 6-pin O. | 4AJ | Cold | — | — | Voltage Regulator | — | — | — | 70 | 5–40 | — | — | 1266 |
| 1267 | Gas Triode | 6-pin O. | 4V | Cold | — | — | Relay Tube | Characteristics same as OA4G | | | | | | | 1267 |
| 2050 | Gas Tetrode | 8-pin O. | 8BA | Htr. | 6.3 | 0.6 | Grid-Controlled Rectifier | 650 | 500 | — | — | 100 | 0.1–10 [7] | 8 | 2050 |
| 2051 | Gas Tetrode | 8-pin O | 8BA | Htr. | 6.3 | 0.6 | Grid-Controlled Rectifier | 350 | 375 | — | — | 75 | 0.1–10 [7] | 14 | 2051 |
| 2523N1/128AS | Gas Triode Grid Type | 5-pin M. | 5A | Htr. | 2.5 | 1.75 | Relay Tube | 400 | 300 | — | — | 1.0 | 300 [7] | 13 | 2523N1/128AS |
| 5651 | Voltage Regulator | 7-pin B. | 5BO | Cold | — | — | Voltage Regulator | 115 | — | 115 | 87 | 1.5–3.5 | — | — | 5651 |
| KY21 | Gas Triode Grid Type | 4-pin M. | — | Fil. | 2.5 | 10.0 | Grid-Controlled Rectifier | — | — | — | 3000 | 500 | — | — | KY21 |
| RK61 | Thyratron | — [9] | — | Fil. | 1.4 | 0.05 | Radio-Controlled Relay | 45 | 1.5 | 30 | — | 0.5–1.5 | 3 [7] | 30 | RK61 |
| RK62 | Gas Triode Grid Type | 4-pin S. | 4D | Fil. | 1.4 | 0.05 | Relay Tube | 45 | 1.5 | — | 30–45 | 0.1–1.5 | — | 15 | RK62 |
| RM208 | Permatron | 4-pin M. | — | Fil. | 2.5 | 5.0 | Controlled Rectifier [1] | 7500 [2] | 1000 | — | — | — | — | 15 | RM208 |
| RM209 | Permatron | 4-pin M. | — | Fil. | 5.0 | 10.0 | Controlled Rectifier [1] | 7500 [2] | 5000 | — | — | — | — | 15 | RM209 |
| OA3/VR75 | Voltage Regulator | 6-pin O. | 4AJ | Cold | — | — | Voltage Regulator | — | — | 105 | 75 | 5–40 | — | — | OA3/VR75 |
| OB3/VR90 | Voltage Regulator | 6-pin O. | 4AJ | Cold | — | — | Voltage Regulator | — | — | 125 | 90 | 5–40 | — | — | OB3/VR90 |
| OC3/VR105 | Voltage Regulator | 6-pin O. | 4AJ | Cold | — | — | Voltage Regulator | — | — | 135 | 105 | 5–40 | — | — | OC3/VR105 |
| OD3/VR150 | Voltage Regulator | 6-pin O. | 4AJ | Cold | — | — | Voltage Regulator | — | — | 185 | 150 | 5–40 | — | — | OD3/VR150 |
| KY866 | Mercury Vapor Triode | 4-pin M. | Fig. 8 | Fil. | 2.5 | 5.0 | Grid-Controlled Rectifier | 10000 | 1000 | 0–150 | — | — | — | — | KY866 |

[1] For use as grid-controlled rectifier or with external magnetic control. RM-208 has characteristics of 866, RM-209 of 872.
[2] When under control peak inverse rating is reduced to 2500.
[3] At 1000 anode volts.
[4] Grid tied to plate.
[5] Peak inverse voltage.
[6] Grid.
[7] Megohms.
[8] Grid voltage.
[9] No base. Tinned wire leads.

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## TABLE XV—RECTIFIERS—RECEIVING AND TRANSMITTING

See also Table XIII—Control and Regulator Tubes

| Type No. | Name | Base | Socket Connections | Cathode | Fil. or Heater | | Max. A.C. Voltage Per Plate | D.C. Output Current Ma. | Max. Inverse Peak Voltage | Peak Plate Current Ma. | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Volts | Amp. | | | | | |
| BA | Full-Wave Rectifier | 4-pin M. | 4J | Cold | — | — | 350 | 350 | Tube drop 80 v. | | G |
| BH | Full-Wave Rectifier | 4-pin M. | 4J | Cold | — | — | 350 | 125 | Tube drop 90 v. | | G |
| BR | Half-Wave Rectifier | 4-pin M. | 4H | Cold | — | — | 300 | 50 | Tube drop 60 v. | | G |
| CE-220 | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 2.5 | 3.0 | — | 20 | 20000 | 100 | HV |
| OY4 | Half-Wave Rectifier | 5-pin O. | 4BU | Cold | Connect Pins 7 and 8 | | 95 | 75 | 300 | 500 | G |
| OZ4 | Full-Wave Rectifier | 5-pin O. | 4R | Cold | — | — | 350 | 30–75 | 1250 | 200 | G |
| 1 | Half-Wave Rectifier | 4-pin S. | 4G | Htr. | 6.3 | 0.3 | 350 | 50 | 1000 | 400 | MV |
| 1-V | Half-Wave Rectifier | 4-pin S. | 4G | Htr. | 6.3 | 0.3 | 350 | 50 | — | — | HV |
| 1B3GT/8016 | Half-Wave Rectifier | 6-pin O. | 3C | Fil. | 1.25 | 0.2 | — | 2.0 | 4000 | 17 | HV |
| 1B48 | Half-Wave Rectifier | 7-pin B. | — | Cold | — | — | 800 | 6 | 2700 | 50 | G |
| 1X2 | Half-Wave Rectifier | 9-pin B. | Fig. 29 | Fil. | 1.25 | 0.2 | — | 1 | 15000 | 10 | HV |
| 1Z2 | Half-Wave Rectifier | 7-pin B. | 7CB | Fil. | 1.5 | 0.3 | 7800 | 2 | 20000 | 10 | HV |
| 2B25 | Half-Wave Rectifier | 7-pin B. | 3T | Fil. | 1.4 | 0.11 | 1000 | 1.5 | — | 9 | HV |
| 2V3G | Half-Wave Rectifier | 6-pin O. | 4Y | Fil. | 2.5 | 5.0 | — | 2.0 | 16500 | 12 | HV |
| 2W3 | Half-Wave Rectifier | 5-pin O. | 4X | Fil. | 2.5 | 1.5 | 350 | 55 | — | — | HV |
| 2X2/879 [10] | Half-Wave Rectifier | 4-pin S. | 4AB | Htr. | 2.5 | 1.75 | 4500 | 7.5 | — | — | HV |
| 2X2-A | Half-Wave Rectifier | 4-pin S. | 4AB | Same as 2X2/879 but will withstand severe shock & vibration | | | | | | | HV |
| 2Y2 | Half-Wave Rectifier | 4-pin M. | 4AB | Fil. | 2.5 | 1.75 | 4400 | 5.0 | — | — | HV |
| 2Z2/G84 | Half-Wave Rectifier | 4-pin M. | 4B | Fil. | 2.5 | 1.5 | 350 | 50 | — | — | HV |
| 3B24 | Half-Wave Rectifier | 4-pin M. | T-4A | Fil. | 5.0<br>2.5 [9] | 3.0<br>3.0 | —<br>— | 60<br>30 | 20000<br>20000 | 300<br>150 | HV |
| 3B25 | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 2.5 | 5.0 | — | 500 | 4500 | 2000 | G |
| 3B26 | Half-Wave Rectifier | 8-pin O. | Fig. 31 | Htr. | 2.5 | 4.75 | — | 20 | 15000 | 8000 | HV |
| DR-3B27 | Half-Wave Rectifier | 4-pin M. | 4B | Fil. | 2.5 | 5.0 | 3000 | 250 | 8500 | 1000 | HV |
| 5AZ4 | Full-Wave Rectifier | 5-pin O. | 5T | Fil. | 5.0 | 2.0 | Same as Type 80 | | | | HV |
| 5R4GY | Full-Wave Rectifier | 5-pin O. | 5T | Fil. | 5.0 | 2.0 | 900 [4]<br>950 [7] | 150 [4]<br>175 [7] | 2800 | 650 | HV |
| 5T4 | Full-Wave Rectifier | 5-pin O. | 5T | Fil. | 5.0 | 3.0 | 450 | 250 | 1250 | 800 | HV |
| 5U4G | Full-Wave Rectifier | 8-pin O. | 5T | Fil. | 5.0 | 3.0 | Same as Type 5Z3 | | | | HV |
| 5V4G | Full-Wave Rectifier | 8-pin O. | 5L | Htr. | 5.0 | 2.0 | Same as Type 83V | | | | HV |
| 5W4 | Full-Wave Rectifier | 5-pin O. | 5T | Fil. | 5.0 | 1.5 | 350 | 110 | 1000 | — | HV |
| 5X3 | Full-Wave Rectifier | 4-pin M. | 4C | Fil. | 5.0 | 2.0 | 1275 | 30 | — | — | HV |
| 5X4G | Full-Wave Rectifier | 8-pin O. | 5Q | Fil. | 5.0 | 3.0 | Same as 5Z3 | | | | HV |
| 5Y3G | Full-Wave Rectifier | 5-pin O. | 5T | Fil. | 5.0 | 2.0 | Same as Type 80 | | | | HV |
| 5Y4G | Full-Wave Rectifier | 8-pin O | 5Q | Fil. | 5.0 | 2.0 | Same as Type 80 | | | | HV |
| 5Z3 | Full-Wave Rectifier | 4-pin M. | 4C | Fil. | 5.0 | 3.0 | 500 | 250 | 1400 | — | HV |
| 5Z4 | Full-Wave Rectifier | 5-pin O. | 5L | Htr. | 5.0 | 2.0 | 400 | 125 | 1100 | — | HV |
| 6W4GT | Damper Service | 6-pin O. | 4CG | Htr. | 6.3 | 1.2 | — | 125 | 2000 | 600 | HV |
| | Half-Wave Rectifier | | | | | | 350 | 125 | 1250 | 600 | |
| 6W5G | Full-Wave Rectifier | 6-pin O. | 6S | Htr. | 6.3 | 0.9 | 350 | 100 | 1250 | 350 | HV |
| 6X4 | Full-Wave Rectifier | 7-pin B. | 7CF | Htr. | 6.3 | 0.6 | 325 | 70 | 1250 | 210 | HV |
| 6X5 | Full-Wave Rectifier | 6-pin O. | 6S | Htr. | 6.3 | 0.5 | 350 | 75 | — | — | HV |
| 6Y3G | Half-Wave Rectifier | 5-pin O. | 4AC | Htr. | 6.3 | 0.7 | 5000 | 7.5 | — | — | HV |
| 6Y5 [10] | Full-Wave Rectifier | 6-pin S. | 6J | Htr. | 6.3 | 0.8 | 350 | 50 | — | — | HV |
| 6Z3 | Half-Wave Rectifier | 4-pin M. | 4G | Fil. | 6.3 | 0.3 | 350 | 50 | — | — | HV |
| 6Z5 [10] | Full-Wave Rectifier | 6-pin S. | 6K | Htr. | 6.3 | 0.6 | 230 | 60 | — | — | HV |
| 6ZY5G | Full-Wave Rectifier | 6-pin O. | 6S | Htr. | 6.3 | 0.3 | 350 | 35 | 1000 | 150 | HV |
| 7Y4 | Full-Wave Rectifier | 8-pin L. | 5AB | Htr. | 6.3 | 0.5 | 350 | 60 | — | — | HV |
| 7Z4 | Full-Wave Rectifier | 8-pin L. | 5AB | Htr. | 6.3 | 0.9 | 450 [1]<br>325 [4] | 100 | 1250 | 300 | HV |
| 12A7 | Rectifier-Pentode | 7-pin S. | 7K | Htr. | 12.6 | 0.3 | 125 | 30 | — | — | HV |
| 12Z3 | Half-Wave Rectifier | 4-pin S. | 4G | Htr. | 12.6 | 0.3 | 250 | 60 | — | — | HV |
| 12Z5 | Voltage Doubler | 7-pin M. | 7L | Htr. | 12.6 | 0.3 | 225 | 60 | — | — | HV |
| 14Y4 | Full-Wave Rectifier | 8-pin L. | 5AB | Htr. | 12.6 | 0.3 | 450 [1]<br>325 [4] | 70 | 1250 | 210 | HV |
| 14Z3 | Half-Wave Rectifier | 4-pin S. | 4G | Htr. | 12.6 | 0.3 | 250 | 60 | — | — | HV |
| 25A7G [10] | Rectifier-Pentode | 8-pin O. | 8F | Htr. | 25 | 0.3 | 125 | 75 | — | — | HV |
| 25W4 | Half-Wave Rectifier | 6-pin O. | 4CG | Htr. | 25 | 0.3 | 350 | 125 | 1250 | 600 | HV |
| 25X6GT | Voltage Doubler | 7-pin O. | 7Q | Htr. | 25 | 0.15 | 125 | 60 | — | — | HV |
| 25Y4GT | Half-Wave Rectifier | 6-pin O. | 5AA | Htr. | 25 | 0.15 | 125 | 75 | — | — | HV |
| 25Y5 [10] | Voltage Doubler | 6-pin S. | 6E | Htr. | 25 | 0.3 | 250 | 85 | — | — | HV |
| 25Z3 | Half-Wave Rectifier | 4-pin S. | 4G | Htr. | 25 | 0.3 | 250 | 50 | — | — | HV |
| 25Z4 | Half-Wave Rectifier | 6-pin O. | 5AA | Htr. | 25 | 0.3 | 125 | 125 | — | — | HV |
| 25Z5 | Rectifier-Doubler | 6-pin S. | 6E | Htr. | 25 | 0.3 | 125 | 100 | — | 500 | HV |
| 25Z6 | Rectifier-Doubler | 7-pin O. | 7Q | Htr. | 25 | 0.3 | 125 | 100 | — | 500 | HV |
| 28Z5 | Full-Wave Rectifier | 8-pin L. | 5AB | Htr. | 28 | 0.24 | 450 [7]<br>325 [4] | 100 | — | 300 | HV |
| 32L7GT | Rectifier-Tetrode | 8-pin O. | 8Z | Htr. | 32.5 | 0.3 | 125 | 60 | — | — | HV |
| 35W4 | Half-Wave Rectifier | 7-pin B. | 5BQ | Htr. | 35 [2] | 0.15 | 125 | 100 [3] | 330 | 600 | HV |
| 35Y4 | Half-Wave Rectifier | 8-pin O. | 5AL | Htr. | 35 [2] | 0.15 | 235 | 60<br>100 [8] | 700 | 600 | HV |
| 35Z3 | Half-Wave Rectifier | 8-pin L. | 4Z | Htr. | 35 | 0.15 | 250 [5] | 100 | 700 | 600 | HV |
| 35Z4GT | Half-Wave Rectifier | 6-pin O. | 5AA | Htr. | 35 | 0.15 | 250 | 100 | 700 | 600 | HV |
| 35Z5G | Half-Wave Rectifier | 6-pin O. | 6AD | Htr. | 35 [2] | 0.15 | 125 | 60<br>100 [8] | — | — | HV |

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# RECEIVING TUBE SUBSTITUTION GUIDE

## TABLE XV—RECTIFIERS—RECEIVING AND TRANSMITTING—*Continued*

**See also Table XIII—Control and Regulator Tubes**

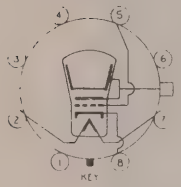
| Type No. | Name | Base | Socket Connections | Cathode | Fil. or Heater | | Max. A.C. Voltage Per Plate | D.C. Output Current Ma. | Max. Inverse Peak Voltage | Peak Plate Current Ma. | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Volts | Amp. | | | | | |
| 35Z6G | Voltage Doubler | 6-pin O. | 7Q | Htr. | 35 | 0.3 | 125 | 110 | — | 500 | HV |
| 40Z5GT | Half-Wave Rectifier | 6-pin O. | 6AD | Htr. | 40 [2] | 0.15 | 125 | 60<br>100 [8] | — | — | HV |
| 45Z3 | Half-Wave Rectifier | 7-pin B. | 5AM | Htr. | 45 | 0.075 | 117 | 65 | 350 | 390 | HV |
| 45Z5GT | Half-Wave Rectifier | 6-pin O. | 6AD | Htr. | 45 [2] | 0.15 | 125 | 60<br>100 [8] | — | — | HV |
| 50X6 | Voltage Doubler | 8-pin L. | 7AJ | Htr. | 50 | 0.15 | 117 | 75 | 700 | 450 | HV |
| 50Y6GT | Full-Wave Rectifier | 7-pin O. | 7Q | Htr. | 50 | 0.15 | 125 | 85 | — | — | HV |
| 50Y7GT | Voltage Doubler | 8-pin L. | 8AN | Htr. | 50 [2] | 0.15 | 117 | 65 | 700 | | HV |
| 50Z6G | Voltage Doubler | 7-pin O. | 7Q | Htr. | 50 | 0.3 | 125 | 150 | — | — | HV |
| 50Z7G [10] | Voltage Doubler | 8-pin O. | 8AN | Htr. | 50 | 0.15 | 117 | 65 | — | — | HV |
| 70A7GT | Rectifier-Tetrode | 8-pin O. | 8AB | Htr. | 70 | 0.15 | 125 [5] | 60 | — | — | HV |
| 70L7GT | Rectifier-Tetrode | 8-pin O. | 8AA | Htr. | 70 | 0.15 | 117 | 70 | — | 350 | HV |
| 72 | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 2.5 | 3.0 | — | 30 | 20000 | 150 | HV |
| 73 | Half-Wave Rectifier | 8-pin O. | 4Y | Fil. | 2.5 | 4.5 | — | 20 | 13000 | 3000 | HV |
| 80 | Full-Wave Rectifier | 4-pin M. | 4C | Fil. | 5.0 | 2.0 | 350 [4]<br>500 [7] | 125<br>125 | 1400 | 375 | HV |
| 81 | Half-Wave Rectifier | 4-pin M. | 4B | Fil. | 7.5 | 1.25 | 700 | 85 | — | — | HV |
| 82 | Full-Wave Rectifier | 4-pin M. | 4C | Fil. | 2.5 | 3.0 | 500 | 125 | 1400 | 400 | MV |
| 83 | Full-Wave Rectifier | 4-pin M. | 4C | Fil. | 5.0 | 3.0 | 500 | 250 | 1400 | 800 | MV |
| 83-V | Full-Wave Rectifier | 4-pin M. | 4AD | Htr. | 5.0 | 2.0 | 400 | 200 | 1100 | — | HV |
| 84/6Z4 | Full-Wave Rectifier | 5-pin S. | 5D | Htr. | 6.3 | 0.5 | 350 | 60 | 1000 | — | HV |
| 117L7GT/<br>117M7GT | Rectifier-Tetrode | 8-pin O. | 8AO | Htr. | 117 | 0.09 | 117 | 75 | — | — | HV |
| 117N7GT | Rectifier-Tetrode | 8-pin O. | 8AV | Htr. | 117 | 0.09 | 117 | 75 | 350 | 450 | HV |
| 117P7GT | Rectifier-Tetrode | 8-pin O. | 8AV | Htr. | 117 | 0.09 | 117 | 75 | 350 | 450 | HV |
| 117Z3 | Half-Wave Rectifier | 7-pin B. | 4BR | Htr. | 117 | 0.04 | 117 | 90 | 330 | — | HV |
| 117Z4GT | Half-Wave Rectifier | 6-pin O. | 5AA | Htr. | 117 | 0.04 | 117 | 90 | 350 | — | HV |
| 117Z6GT | Voltage Doubler | 7-pin O. | 7Q | Htr. | 117 | 0.075 | 235 | 60 | 700 | 360 | HV |
| 217-A [10] | Half-Wave Rectifier | 4-pin J. | 4AT | Fil. | 10 | 3.25 | — | — | 3500 | 600 | HV |
| 217-C | Half-Wave Rectifier | 4-pin J. | 4AT | Fil. | 10 | 3.25 | — | — | 7500 | 600 | HV |
| Z225 | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 2.5 | 5.0 | — | 250 | 10000 | 1000 | MV |
| 249-B | Half-Wave Rectifier | 4-pin M. | Fig. 53 | Fil. | 2.5 | 7.5 | 3180 | 375 | 10000 | 1500 | MV |
| HK253 | Half-Wave Rectifier | 4-pin J. | 4AT | Fil. | 5.0 | 10 | — | 350 | 10000 | 1500 | HV |
| 705A<br>RK-705A | Half-Wave Rectifier | 4-pin W. | T-3AA | Fil. | 2.5 [9]<br>5.0 | 5.0<br>5.0 | —<br>— | 50<br>100 | 35000<br>35000 | 375<br>750 | HV |
| 816 | Half-Wave Rectifier | 4-pin S. | 4P | Fil. | 2.5 | 2.0 | 2200 | 125 | 7500 | 500 | MV |
| 836 | Half-Wave Rectifier | 4-pin M. | 4P | Htr. | 2.5 | 5.0 | — | — | 5000 | 1000 | HV |
| 866A/866 | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 2.5 | 5.0 | 3500 | 250 | 10000 | 1000 | MV |
| 866B | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 5.0 | 5.0 | — | — | 8500 | 1000 | MV |
| 866 Jr. | Half-Wave Rectifier | 4-pin M. | 4B | Fil. | 2.5 | 2.5 | 1250 | 250 [3] | — | — | MV |
| HY866 Jr. | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 2.5 | 2.5 | 1750 | 250 [3] | 5000 | — | MV |
| RK866 | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 2.5 | 5.0 | 3500 | 250 | 10000 | 1000 | MV |
| 871 [10] | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 2.5 | 2.0 | 1750 | 250 | 5000 | 500 | MV |
| 878 | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 2.5 | 5.0 | 7100 | 5 | 20000 | — | HV |
| 879 | Half-Wave Rectifier | 4-pin S. | 4P | Fil. | 2.5 | 1.75 | 2650 | 7.5 | 7500 | 100 | HV |
| 872A/872 | Half-Wave Rectifier | 4-pin J. | 4AT | Fil. | 5.0 | 7.5 | — | 1250 | 10000 | 5000 | MV |
| 975A | Half-Wave Rectifier | 4-pin J. | 4AT | Fil. | 5.0 | 10.0 | — | 1500 | 15000 | 6000 | MV |
| OZ4A/<br>1003 | Full-Wave Rectifier | 5-pin O. | 4R | Cold | — | — | — | 110 | 880 | — | G |
| 1005/<br>CK1005 | Full-Wave Rectifier | 8-pin O. | 5AQ | Fil. | 6.3 | 0.1 | — | 70 | 450 | 210 | G |
| 1006/<br>CK1006 | Full-Wave Rectifier | 4-pin M. | 4C | Fil. | 1.75 | 2.25 | — | 200 | 1600 | — | G |
| CK1007 | Full-Wave Rectifier | 8-pin O. | T-9G | Fil. | 1.0 | 1.2 | — | 110 | 980 | — | G |
| CK1009/BA | Full-Wave Rectifier | 4-pin M. | — | Cold | — | — | — | 350 | 1000 | — | G |
| 1274 | Full-Wave Rectifier | 6-pin O. | 6S | Htr. | 6.3 | 0.6 | Same as 7Y4 | | | | HV |
| 1275 | Full-Wave Rectifier | 4-pin M. | 4C | Fil. | 5.0 | 1.75 | Same as 5Z3 | | | | HV |
| 1616 | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 2.5 | 5.0 | — | 130 | 6000 | 800 | HV |
| 1641/<br>RK60 | Full-Wave Rectifier | 4-pin M. | T-4AG | Fil. | 5.0 | 3.0 | — | 50<br>250 | 4500<br>2500 | —<br>— | HV |
| 1654 | Half-Wave Rectifier | 7-pin B. | 2Z | Fil. | 1.4 | 0.05 | 2500 | 1 | 7000 | 6 | HV |
| 5517 | Half-Wave Rectifier | 7-pin B. | 5BU | Cold | — | — | 1200 | 6 | — | 50 | G |
| 5825 | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 1.6 | 1.25 | — | 2 | 60000 | 40 | HV |
| 8008 | Half-Wave Rectifier | 4-pin [6] | Fig. 11 | Fil. | 5.0 | 7.5 | — | 1250 | 10000 | 5000 | MV |
| 8013A | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 2.5 | 5.0 | — | 20 | 40000 | 150 | HV |
| 8016 | Half-Wave Rectifier | 6-pin O. | 4AC | Fil. | 1.25 | 0.2 | — | 2.0 | 10000 | 7.5 | HV |
| 8020 | Half-Wave Rectifier | 4-pin M. | 4P | Fil. | 5.0 | 5.5 | 10000 | 100 | 40000 | 750 | HV |
| | | | | | 5.8 | 6.5 | 12500 | 100 | 40000 | 750 | |
| RK19 | Full-Wave Rectifier | 4-pin M. | 4AT | Htr. | 7.5 | 2.5 | 1250 | 200 [4] | 3500 | 600 | HV |
| RK21 | Half-Wave Rectifier | 4-pin M. | 4P | Htr. | 2.5 | 4.0 | 1250 | 200 [4] | 3500 | 600 | HV |
| RK22 | Full-Wave Rectifier | 4-pin M. | T-4AG | Htr. | 2.5 | 8.0 | 1250 | 200 [4] | 3500 | 600 | HV |

[1] With input choke of at least 20 henrys.
[2] Tapped for pilot lamps.
[3] Per pair with choke input.
[4] Condenser input.
[5] With 100 ohms min. resistance in series with plate; without series resistor, maximum r.m.s. plate rating is 117 volts.
[6] Same as 872A/872 except for heavy-duty push-type base. Filament connected to pins 2 and 3, plate to top cap.
[7] Choke input.
[8] Without panel lamp.
[9] Using only one-half of filament.
[10] Discontinued.

*Courtesy ARRL Handbook*

# CATHODE-RAY TUBE BASES

4AE



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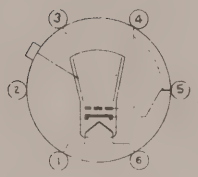

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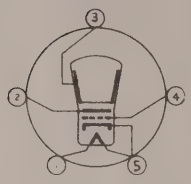

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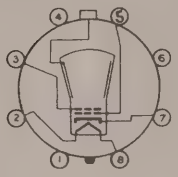

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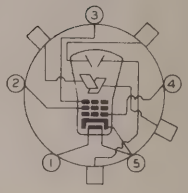

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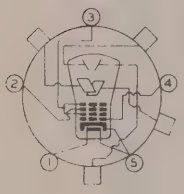

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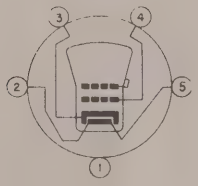

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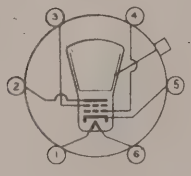

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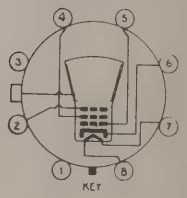

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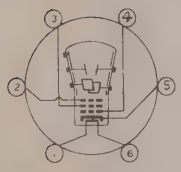

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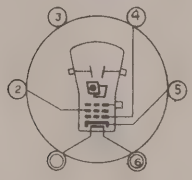

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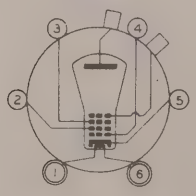

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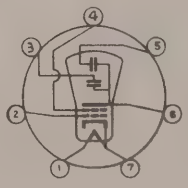

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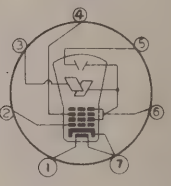

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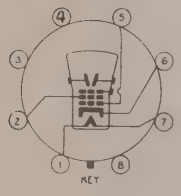

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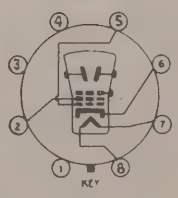

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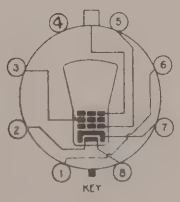

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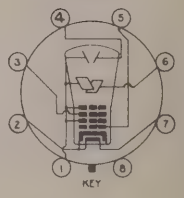

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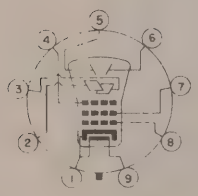

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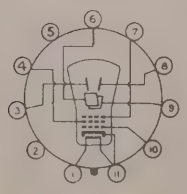

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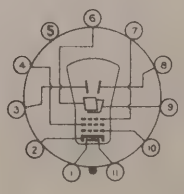

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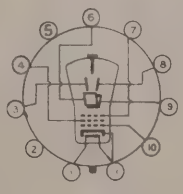

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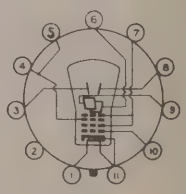

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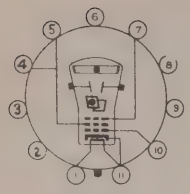

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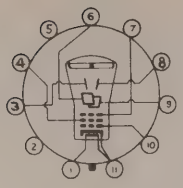

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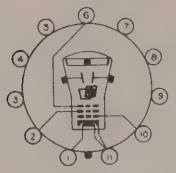

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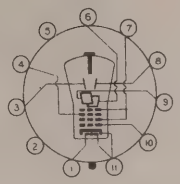

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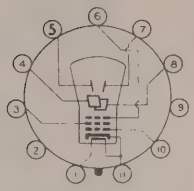

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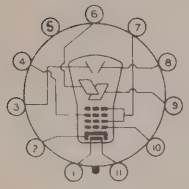

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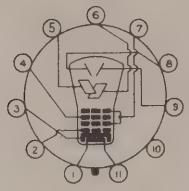

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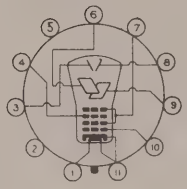

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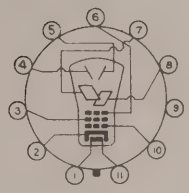

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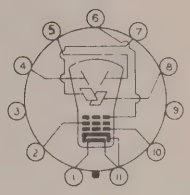

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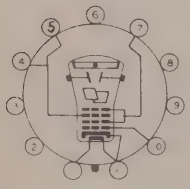

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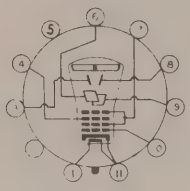

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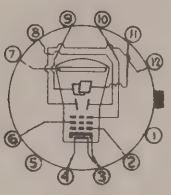

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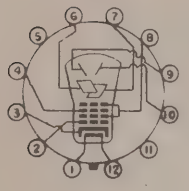

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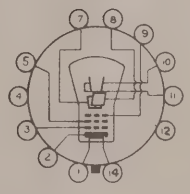

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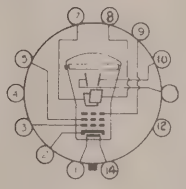

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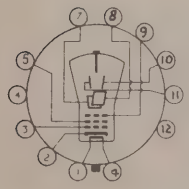

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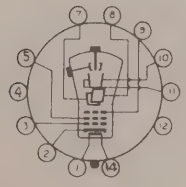

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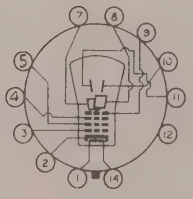
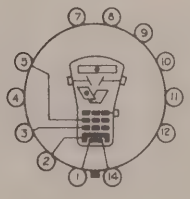
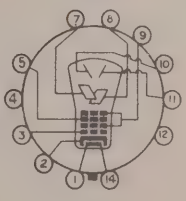


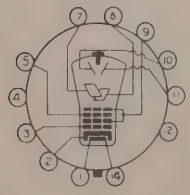
14F



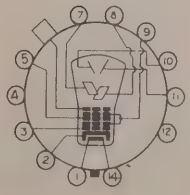
14G



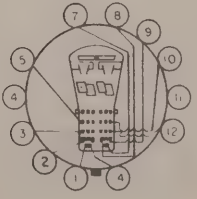
14H



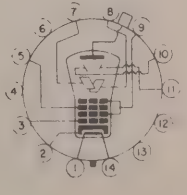
14J



14K



14L



# CATHODE-RAY TUBE CHARACTERISTICS

## ELECTROSTATIC TYPES—CATHODE RAY TUBES

| Type | Heater | | Nominal Dimensions | | Base | RMA Basing | Screen | | Maximum Design Center Ratings | | | | Typical Operating Conditions | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volts | Amperes | Diameter Inches | Length Inches | | | Fluorescence | Persistence | Anode #1 Volts | Anode #2 Volts | Anode #3 Volts | Anode #2 to Deflection Plate Peak Volts | Anode #2 Volts | Anode #1 Avg. Volts** | Anode #3 Volts | Grid Range Volts* | Deflection Avg. Volts DC/Inch D 1-2 | Deflection Avg. Volts DC/Inch D 3-4 |
| 2AP1 )<br>2AP1A) | 6.3 | 0.6 | 2 | 7-7/16 | Small Shell<br>Magnal 11 Pin | 11B<br>11L | Green | Medium | 500 | 1000 | .... | 600 | 500<br>1000 | 125<br>250 | ....<br>.... | 15-45<br>30-90 | 115<br>230 | 98<br>196 |
| 2BP1 | 6.3 | 0.6 | 2-1/16 | 7-5/8 | Small Shell<br>Duodecal 12 Pin | 12F<br>12F | Green | Medium | 1000 | 2500 | .... | 500 | 1000<br>2000 | 150-280<br>300-560 | ....<br>.... | 0-67.5<br>0-135 | 115-155<br>230-310 | 74-100<br>148-200 |
| 3AP1 )<br>3AP1A)<br>3AP4 ) | 2.5 | 2.1 | 3 | 11-1/2 | Medium 7 Pin | 7AN<br>7CE<br>7AN | Green<br>Green<br>White | Medium<br>Medium<br>Medium | 1000 | 1500 | .... | 600 | 600<br>800<br>1000<br>1200<br>1500 | 170<br>230<br>285<br>345<br>475 | ....<br>....<br>....<br>....<br>.... | 14-40<br>14-40<br>17-50<br>20-60<br>22.5-67.5 | 47<br>61<br>76<br>91<br>114 | 45<br>58<br>73<br>87<br>109 |
| 3BP1 )<br>3BP1A) | 6.3 | 0.6 | 3 | 10 | Medium Shell<br>Diheptal 12 Pin | 14A<br>14A | Green<br>Green | Medium<br>Medium | 1000 | 2000 | .... | 500 | 1500<br>2000 | 430<br>575 | ....<br>.... | 22.5-67.5<br>30-90 | 168<br>221 | 123<br>164 |
| 3CP1 | 6.3 | 0.6 | 3 | 10-3/8 | Medium<br>Magnal 11 Pin, Sleeve | 11C | Green | Medium | 1000 | 2000 | .... | 500 | 1500<br>2000 | 430<br>575 | ....<br>.... | 22.5-67.5<br>30-90 | 165.5<br>124 | 221<br>165 |
| 3DP1 )<br>3DP1A) | 6.3 | 0.6 | 3 | 10-7/16 | Medium Shell<br>Diheptal 12 Pin | 14C<br>14H | Green | Medium | 1000 | 2000 | .... | 500 | 1500<br>2000 | 430<br>575 | ....<br>.... | 22.5-67.5<br>30-90 | 166<br>221 | 123<br>164 |
| 3EP1 | 6.3 | 0.6 | 3 | 9-15/16 | Large Wafer<br>Magnal 11 Pin, Sleeve | 11A | Green | Medium | 1000 | 2000 | .... | 500 | 1500<br>2000 | 430<br>575 | ....<br>.... | 22.5-67.5<br>30-90 | 165.5<br>221 | 124<br>165 |
| 3FP7<br>3FP7A | 6.3 | 0.6 | 3 | 10 | Medium Shell<br>Diheptal 12 Pin | 14B<br>14J | Characteristics of Phosphor No.7 | | 1000 | 2000 | 4000 | 500 | 2000<br>1500<br>2000 | 575<br>430<br>575 | 2000<br>3000<br>4000 | 30-90<br>22.5-67.5<br>30-90 | 221<br>221<br>295 | 164<br>163<br>217 |
| 3GP1<br>3GP4 | 6.3 | 0.6 | 3 | 11-1/2 | Medium Shell<br>Magnal 11 Pin | 11A<br>11A | Green<br>White | Medium<br>Medium | 1000 | 1500 | .... | 500 | 1000<br>1500 | 234<br>350 | ....<br>.... | 16.5-49.5<br>25-75 | 80<br>120 | 70<br>105 |
| 3GP1A<br>3GP4A | 6.3 | 0.6 | 3 | 11-1/2 | Medium Shell<br>Magnal 11 Pin | 11N<br>11N | Green<br>White | Medium<br>Medium | 1000 | 1500 | .... | 550 | 1000<br>500 | 163-291<br>245-437 | ....<br>.... | 16.5-49.5<br>25-75 | 64-96<br>96-144 | 56-84<br>84-126 |
| 3JP1 | 6.3 | 0.6 | 3 | 10 | Medium Shell<br>Diheptal 12 Pin | 14J<br>14J | Green | Medium | 1000 | 2000 | 4000 | 500 | 500<br>2000<br>500<br>2000 | 430<br>575<br>430<br>575 | 1500<br>2000<br>3000<br>4000 | 22.5-67.5<br>30-90<br>22.5-67.5<br>30-90 | 120<br>160<br>150<br>200 | 89<br>119<br>111<br>148 |
| 3KP1<br>3KP4 | 6.3 | 0.6 | 3 | 11-1/2 | Medium Shell<br>Magnal 11 Pin | 11M<br>11M | Green<br>White | Medium<br>Medium | 1000 | 2500 | .... | 500 | 1000<br>2000 | 160-300<br>320-600 | ....<br>.... | 0-45<br>0-90 | 50-68<br>100-136 | 38-52<br>76-104 |
| 3MP1 | 6.3 | 0.6 | 3 | 8 | Small Shell<br>Duodecal 12 Pin | 12F | Green | Medium | 1000 | 2500 | .... | 500 | 1000<br>2000 | 200-350<br>400-700 | ....<br>.... | 0-63<br>0-126 | 140-190<br>280-380 | 130-180<br>260-360 |
| 3QP1 | 6.3 | 0.3 | 2-3/4 | 6-1/8 | European 9 Pin | 9D | Green | Medium | 700 | 1500 | .... | 550 | 800<br>1200 | 200-320<br>240-480 | ....<br>.... | 21-50<br>31-74 | 143-193<br>214-290 | 89-121<br>133-181 |
| 3RP1<br>3RP1A | 6.3 | 0.6 | 3 | 9-1/8 | Small Shell Duodecal<br>12 Pin | 12E | Green | Medium | 1000 | 2500 | .... | 500 | 1000<br>2000 | 165-310<br>330-620 | ....<br>.... | 67.5<br>13.5 | 85<br>61 | 172<br>122 |
| 3SP1<br>3SP4 | 6.3 | 0.6 | 3x1-1/2 | 9-1/8 | Small Shell<br>Duodecal 12 Pin | 12E | Green<br>White | Medium<br>Medium | 1100 | 2750 | .... | ... | 1000<br>2000 | 165-310<br>330-620 | ....<br>.... | 28.5-67.5<br>58-135 | 73-99<br>146-198 | 52-70<br>104-140 |
| 5AP1 | 6.3 | 0.6 | 5-1/4 | 13 | Large Wafer<br>Magnal 11 Pin, Sleeve | 11A | Green | Medium | 1200 | 2000 | .... | 500 | 1500<br>2000 | 430<br>575 | ....<br>.... | 31-57<br>40-74 | 93 | 90 |
| 5AP4 | 6.3 | 0.6 | 5-1/4 | 13 | Large Wafer<br>Magnal 11 Pin, Sleeve | 11A | White | Medium | 1200 | 2000 | .... | 500 | 1500<br>2000 | 430<br>575 | ....<br>.... | 17.6-57<br>22.8-74 | 93 | 90 |
| 5BP1<br>5BP4 | 6.3 | 0.6 | 5-1/4 | 16-3/4 | Large Wafer<br>Magnal 11 Pin | 11A<br>11A | Green<br>White | Medium<br>Medium | 1000 | 2000 | .... | 500 | 1500<br>2000 | 310<br>425 | ....<br>.... | 20-60 | 63<br>84 | 57<br>76 |
| 5BP1A | 6.3 | 0.6 | 5-1/4 | 16-3/4 | Medium Shell<br>Magnal 11 Pin | 11N | Green | Medium | 1000 | 2000 | .... | 500 | 1500<br>2000 | 337-450 | .... | 15-45<br>20-60 | 63<br>84 | 57<br>76 |
| 5BP7A | 6.3 | 0.6 | 5-1/4 | 16-3/4 | Medium Shell<br>Magnal 11 Pin | 11N | Characteristics of P7 Screen | | 1000 | 2000 | .... | 500 | 1500<br>2000 | 235-420<br>315-560 | ....<br>.... | 15-45<br>20-60 | 52-74<br>70-98 | 47-67<br>63-89 |

*Cut-off voltage. Supply should be adjustable from 0 to value shown.

**Bogey value for focus. Voltage should be adjustable about value shown.

Commonly used Phosphors only listed.

*Courtesy Sylvania Electric Products Inc.*

## ELECTROSTATIC TYPES—CATHODE RAY TUBES

| Type | Heater | | Nominal Dimensions | | Base | RMA Basing | Screen | | Maximum Design Center Ratings | | | | Typical Operating Conditions | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volts | Amperes | Diameter Inches | Length Inches | | | Fluorescence | Persistence | Anode #1 Volts | Anode #2 Volts | Anode #3 Volts | Anode #2 to Deflection Plate Peak Volts | Anode #2 Volts | Anode #1 Avg. Volts** | Anode #3 Volts | Grid Bange Volts* | Deflection Avg. Volts DC/Inch D 1-2 | Deflection Avg. Volts DC/Inch D 3-4 |
| 5CP1<br>5CP4 | 6.3 | 0.6 | 5-1/4 | 16-3/4 | Medium Shell<br>Diheptal 12 Pin | 14B<br>14B | Green<br>White | Medium<br>Medium | 1000 | 2000 | 4000 | 500 | 2000<br>1500<br>2000 | 575<br>430<br>575 | 2000<br>3000<br>4000 | 30-90<br>22.5-67.5<br>30-90 | 73<br>69<br>92 | 64<br>56<br>74 |
| 5CP1A | 6.3 | 0.6 | 5-1/4 | 16-3/4 | Medium Shell<br>Diheptal 12 Pin | 14J<br>14J | Green | Medium | 1000 | 2000 | 4000 | 500 | 2000<br>1500<br>2000 | 575<br>430<br>575 | 2000<br>3000<br>4000 | 30-90<br>22.5-67.5<br>30-90 | 73<br>69<br>92 | 64<br>56<br>74 |
| 5GP1 | 6.3 | 0.6 | 5-1/4 | 16-3/4 | Large Wafer<br>Magnal 11 Pin, Sleeve | 11A | Green | Medium | 1000 | 2000 | .... | 500 | 2000 | 425 | .... | 24-56 | 36 | 72 |
| 5HP1<br>5HP4 | 6.3 | 0.6 | 5-1/4 | 16-3/4 | Large Wafer<br>Magnal 11 Pin, Sleeve | 11A<br>11A | Green<br>White | Medium<br>Medium | 1000 | 2000 | .... | 500 | 1500<br>2000 | 310<br>425 | .... | 15-45<br>20-60 | 63.5<br>84.8 | 57.8<br>77.0 |
| 5HP1A | 6.3 | 0.6 | 5-1/4 | 16-3/4 | Large Wafer Magnal<br>11 Pin, Micanol | 11N | Green | Medium | 1000 | 2000 | .... | 500 | 1500<br>2000 | 337<br>450 | .... | 15-45<br>20-60 | 63<br>84 | 57<br>76 |
| 5JP1<br>5JP4 | 6.3 | 0.6 | 5-5/16 | 16-3/4 | Medium<br>Magnal 11 Pin | 11E<br>11E | Green<br>White | Medium<br>Medium | 1000 | 2000 | 4000 | 500 | 1000<br>2000 | 260<br>520 | 2000<br>4000 | 22.2-51.8<br>45-105 | 96 | 96 |
| 5JP1A<br>5JP4A | 6.3 | 0.6 | 5-5/16 | 16-3/4 | Medium<br>Magnal 11 Pin | 11S<br>11S | Green<br>White | Medium<br>Medium | 1000 | 2000 | 4000 | 500 | 1500<br>2000 | 250-472<br>333-630 | 3000<br>4000 | 34-79<br>45-105 | 58-86<br>77-115 | 58-86<br>77-115 |
| 5LP1<br>5LP4 | 6.3 | 0.6 | 5-5/16 | 16-3/4 | Medium<br>Magnal 11 Pin, Sleeve | 11F<br>11F | Green<br>White | Medium<br>Medium | 1000 | 2000 | 4000 | 500 | 1000<br>1500<br>2000 | 250<br>375<br>500 | 2000<br>3000<br>4000 | 15-45<br>22.5-67.5<br>30-90 | 52<br>77<br>103 | 45<br>68<br>90 |
| 5LP1A<br>5LP4A | 6.3 | 0.6 | 5-5/16 | 16-3/4 | Medium<br>Magnal 11 Pin, Sleeve | 11T<br>11T | Green<br>White | Medium<br>Medium | 1000 | 2000 | 4000 | 550 | 1500<br>2000 | 282-475<br>376-633 | 3000<br>4000 | 22.5-67.5<br>30-90 | 62-93<br>83-124 | 54-81<br>72-108 |
| 5MP1<br>5MP4 | 2.5 | 2.1 | 5-5/16 | 15-7/8 | Large 7 Pin | 7AN<br>7AN | Green<br>White | Medium<br>Medium | 1000 | 1500 | .... | 600 | 1000<br>1500 | 250<br>375 | .... | 16.5-49.5<br>15-45 | 66 | 60 |
| 5NP1<br>5NP4 | 6.3 | 0.6 | 5-5/16 | 16-3/4 | Large Wafer Magnal<br>11 Pin, Sleeve | 11A<br>11A | Green<br>White | Medium<br>Medium | 1000 | 2000 | .... | 500 | 1500<br>2000 | 337<br>450 | .... | 15-45<br>20-60 | 84 | 76 |
| 5RP1<br>5RP4 | 6.3 | 0.6 | 5-1/4 | 16-3/4 | Medium Shell<br>Diheptal 12 Pin | 14F<br>14F | Green<br>White | Medium<br>Medium | 15550 | 3500 | 25500 | 1200 | 2000<br>2000 | 518<br>528 | 10000<br>20000 | 30-90<br>30-90 | 30-45<br>36-54 | 30-45<br>36-54 |
| 5RP1A<br>5RP4A | 6.3 | 0.6 | 5-1/4 | 16-3/4 | Medium Shell<br>Diheptal 12 Pin | 14F | Green<br>White | Medium<br>Medium | 15550 | 3500 | 25500 | 1200 | 2000<br>2000 | 518<br>528 | 10000<br>20000 | 30-90<br>30-90 | 30-45<br>36-54 | 30-45<br>36-54 |
| 5SP1<br>5SP4 | 6.3 | 0.6 | 5-1/4 | 18-1/2 | Medium Shell<br>Diheptal 12 Pin | 14K<br>14K | Green<br>White | Medium<br>Medium | 1000 | 2000 | 4000 | 500 | 1500<br>1500<br>2000 | 431<br>431<br>575 | 1500<br>3000<br>4000 | 22.5-67.5<br>22.5-67.5<br>30-90 | 55<br>69<br>92 | 48<br>59<br>79 |
| 5UP1 | 6.3 | 0.6 | 5-1/4 | 14-3/4 | Small Shell<br>Duodecal 12 Pin | 12E | Green | Medium | 1000 | 2500 | .... | 500 | 1000<br>2000 | 170-320<br>340-640 | .... | 22.5-67.5<br>30-90 | 28-38.5<br>56-77 | 28-31<br>46-62 |
| 5VP7 | 6.3 | 0.6 | 5-1/4 | 16-3/4 | Medium Shell<br>Magnal 11 Pin | 11N | Characteristics of Phosphor No. 7 | | 1000 | 2500 | .... | 500 | 1500<br>2000 | 236-422<br>315-562 | .... | 15-45<br>20-60 | 52-74<br>70-98 | 47-67<br>63-89 |
| 5XP1 | 6.3 | 0.6 | 5-1/4 | 17-5/8 | Medium Shell<br>Diheptal 12 Pin | 14F | Green | Medium | 1550 | 3500 | 25500 | 1200 | 2000<br>2000<br>2000 | 362-695<br>362-695<br>362-695 | 4000<br>10000<br>20000 | 30-90<br>30-90<br>30-90 | 72-108<br>102-695<br>362-695 | 24-36<br>34-52<br>46-68 |
| 7EP4 | 6.3 | 0.6 | 7 | 15-1/2 | Medium Shell<br>Magnal 11 Pin | 11N | White | Medium | 1500 | 3300 | .... | 700 | 2500 | 650 | .... | 36-84 | 110 | 95 |
| 7GP4 | 6.3 | 0.6 | 7 | 14-1/2 | Medium Shell<br>Diheptal 12 Pin | 14G | White | Medium | 1500 | 4000 | .... | 500 | 3000 | 810-1200 | .... | 36-84 | 93-123 | 75-102 |
| 7JP1<br>7JP4 | 6.3 | 0.6 | 7 | 14-1/2 | Medium Shell<br>Diheptal 12 Pin | 14G | Green<br>White | Medium<br>Medium | 2800 | 6000 | .... | 750 | 6000 | 1620-2400 | .... | 72-168 | 186-246 | 150-204 |
| 8BP4 | 6.3 | 0.6 | 8-3/4 | 16-1/2 | Medium Shell<br>Diheptal 12 Pin | 14G | White | Medium | 3100 | 6600 | .... | 750 | 6000 | 2000 | .... | 72-168 | 146-198 | 124-198 |
| 9NP1 | 2.5 | 2.1 | 9 | 21 | Medium 6 Pin | 6BN | Green | Medium | 1500 | 5500 | .... | 1500 | 5000 | 1150 | .... | 45-135 | 190 | 175 |

* Cut-off voltage. Supply should be adjustable from 0 to value shown.

** Bogey value for focus. Voltage should be adjustable about value shown.

*Courtesy Sylvania Electric Products Inc.*

## ELECTROSTATIC TYPES—CATHODE RAY TUBES

| Type | Heater | | Nominal Dimensions | | Base | RMA Basing | Screen | | Maximum Design Center Ratings | | | | Typical Operating Conditions | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volts | Amperes | Diameter Inches | Length Inches | | | Fluorescence | Persistence | Anode #1 Volts | Anode #2 Volts | Anode #3 Volts | Anode #2 to Deflection Plate, Peak Volts | Anode #2 Volts | Anode #1 Avg. Volts** | Anode #3 Volts | Grid Bange Volts* | Deflection Avg. Volts DC/Inch D 1-2 | Deflection Avg. Volts DC/Inch D 3-4 |
| 10GP4 | 6.3 | 0.6 | 10 | 18-1/2 | Medium Shell Diheptal 12 Pin | 14G | White | Medium | 2000 | [illegible] | .... | 500 | 1500 | 1130-1660 | . . . | 54-126 | 1[illegible]-145 | 90-127 |
| | | | | | | | | | | | | | [illegible]0 | 1250-1850 | | 60-140 | 125-[illegible]65 | 100-135 |
| 10HP4 | 6.3 | 0.6 | 10 | 19-1/4 | Medium Shell Diheptal 12 Pin | 14G | White | Medium | 2000 | [illegible] | .... | 600 | 4000 | 960-1440 | . . . | 48-112 | 88-120 | 68-92 |
| | | | | | | | | | | | | | 5000 | 1200-1800 | .... | 60-140 | 110-150 | 85-115 |
| 12HP7 | 6.3 | 0.6 | 12 | 24 | Medium Shell Diheptal 12 Pin | 14E | Characteristics of Phosphor No. 7 | | 2000 | 4000 | 8000 | 1000 | 2000 | 625 | 4000 | 30-90 | 55 | 63 |
| | | | | | | | | | | | | | 4000 | 1250 | 4000 | 30-90 | | |
| | | | | | | | | | | | | | 3000 | 937 | 6000 | 30-90 | 83 | 94 |
| | | | | | | | | | | | | | 4000 | 1250 | 8000 | 30-90 | 110 | 125 |
| 12GP7 | 6.3 | 0.6 | 12 | 22 | Medium Shell Diheptal 12 Pin | 14B | Characteristics of Phosphor No. 7 | | 2000 | 4000 | 6000 | 1000 | 3000 | 857 | 3000 | 49-147 | 73 | 68 |
| | | | | | | | | | | | | | 3000 | 857 | 6000 | 49-147 | 89 | 83 |
| | | | | | | | | | | | | | 4000 | 1143 | 4000 | 65-195 | 97 | 91 |
| | | | | | | | | | | | | | 4000 | 1143 | 6000 | 65-195 | 108 | 101 |
| 12HP1 | 6.3 | 0.6 | 12 | 23-1/2 | Medium Magnal 11 Pin, Sleeve | 11J | Green | Medium | 1500 | 5500 | .... | 1000 | 5000 | 1150 +25% −30% | .... | 45-135 | 19 | 25 |
| 14AP1 | 2.5 | 2.1 | 13-3/8 | 24-1/4 | 12 Pin Peripheral Contact | 12A | Green | Medium | 1800 | 4000 | 8000 | .... | 2000 | 500 | 4000 | 20-60 | 65 | 65 |
| 14AP4 | | | | | | 12A | White | Medium | | | | | 4000 | 1000 | 8000 | 40-120 | 130 | 130 |
| 20AP1 | 2.5 | 2.1 | 20 | 27-7/8 | 12 Pin Peripheral Contact | 12A | Green | Medium | 1800 | 4000 | 8000 | .... | 2000 | 500 | 4000 | 20-60 | 55 | 55 |
| 20AP4 | 2.5 | 2.1 | 20 | 27-7/8 | | 12A | White | Medium | 1800 | 4000 | 8000 | .... | 4000 | 1000 | 8000 | 40-120 | 110 | 110 |
| | | | | | | | | | | | | | 2000 | 500 | 4000 | 20-60 | 65 | 65 |
| | | | | | | | | | | | | | 4000 | 1000 | 8000 | 40-120 | 130 | 130 |
| 902 | 6.3 | 0.6 | 2 | 7-1/2 | Medium Shell Octal 8 Pin | 8CD | Green | Medium | 300 | 600 | .... | 347 | 400 | 100 | .... | 20-60 | 93 | 78 |
| | | | | | | | | | | | | | 600 | 150 | .... | 30-90 | 139 | 117 |
| 902-A | 6.3 | 0.6 | 2 | 7-7/16 | Medium Shell Octal 8 Pin | 8CD | Green | Medium | 300 | 600 | .... | 347 | 400 | 100 | .... | 20-60 | 93 | 78 |
| | | | | | | | | | | | | | 600 | 150 | .... | 30-90 | 139 | 117 |
| 905 | 2.5 | 2.1 | 5-1/4 | 16-1/2 | Long Shell Medium 5 Pin Micanol | 5BP | Green | Medium | 600 | 2000 | .... | 1000 | 1500 | 338 | .... | 13-39 | 86 | 73 |
| 907 | | | | | | 5BP | Blue | Very Short | | | | | 2000 | 450 | .... | 17.5-52.5 | 115 | 97 |
| 909 | | | | | | 5BP | Bluish-White | Long | | | | | | | | | | |
| 905-A | 2.5 | 2.1 | 5-1/4 | 16-1/2 | Long Shell Medium 5 Pin Micanol | 5BR | Green | Medium | 600 | 2000 | .... | 1000 | 1500 | 338 | .... | 13-39 | 86 | 73 |
| | | | | | | | | | | | | | 2000 | 450 | .... | 17.5-52.5 | 115 | 97 |
| 908 | 2.5 | 2.1 | 3 | 11-1/2 | Medium 7 Pin | 7AN | Bluish | Very Short | 1000 | 1500 | .... | 600 | 600 | 170 | .... | | 46.3 | 44 |
| 910 | | | | | | 7AN | Bluish-White | Long | | | | | 800 | 230 | .... | | 62 | 57.8 |
| | | | | | | | | | | | | | 1000 | 285 | .... | 13-46 | 77 | 72.5 |
| | | | | | | | | | | | | | 1200 | 345 | .... | | 94 | 88 |
| | | | | | | | | | | | | | 1500 | 475 | .... | 30-70 | 115.2 | 110 |
| 908-A | 2.5 | 2.1 | 3 | 11-1/2 | Medium 7 Pin | 7CE | Blue | Very Short | 1000 | 1500 | .... | 500 | 1000 | 287 | .... | 16.5-49.5 | 76 | 73 |
| | | | | | | | | | | | | | 1500 | 430 | .... | 25-75 | 114 | 109 |
| 912 | 2.5 | 2.1 | 5-1/4 | 16-1/2 | Medium 5 Pin Micanol | 912 | Green | Medium | 4500 | 1500 | .... | 7000 | 5000 | 1000 | .... | 27-81 | 306 | 248 |
| | | | | | | | | | | | | | 10,000 | 2000 | .... | 31-93 | 620 | 498 |
| | | | | | | | | | | | | | 15,000 | 3000 | .... | 35-105 | 910 | 746 |
| 913 | 6.3* | 0.6 | 1-5/8 | 4-3/4 | Small Wafer Octal 8 Pin | 913 | Green | Medium | 200 | 500 | .... | 250 | 250 | 50 | .... | 10-30 | 169 | 121 |
| | | | | | | | | | | | | | 500 | 100 | .... | 32-98 | 363 | 254 |
| 914 | 2.5 | 2.1 | 9-1/4 | 21-1/2 | Medium 6 Pin | 6BF | Green | Medium | 1900 | 7000 | .... | 3000 | 1500 | 300 | .... | 25-75 | 75 | 58.7 |
| | | | | | | | | | | | | | 2500 | 515 | .... | 25-75 | 124.5 | 97.8 |
| | | | | | | | | | | | | | 5000 | 1030 | .... | 25-75 | 248 | 195 |
| | | | | | | | | | | | | | 7000 | 1450 | .... | 25-75 | 348 | 274 |
| 914A | 2.5 | 2.1 | 9-1/4 | 20-1/16 | Medium 6 Pin | 914A | Green | Medium | 1900 | 7000 | .... | 3000 | 1500 | 320 | .... | 25-75 | 69.5 | 54.6 |
| | | | | | | | | | | | | | 2500 | 550 | .... | 25-75 | 115 | 91 |
| | | | | | | | | | | | | | 5000 | 1100 | .... | 25-75 | 231 | 182 |
| | | | | | | | | | | | | | 7000 | 1550 | .... | 25-75 | 323 | 254 |
| VCR 139A | 4.0 | 1.1 | 2-3/4 | 7-7/8 | European | VCR 139A | Green | Medium | 1000 | 1000 | .... | | 800 | 120-150 | .... | 7-16 | 104 | 140 |

* Cut-off voltage. Supply should be adjustable from 0 to value shown.

** Bogey value for focus. Voltage should be adjustable about value shown.

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## MAGNETIC TYPE CATHODE RAY TUBES

| Type No. | Heater | | Bulb | | | | | Deflection Angle in Degrees (Note 1) | Ion Trap Required | Base | RMA Basing | μμf Filter Capacitance Provided by Bulb Coating | Deflection and Focusing Method | Maximum Design Center Ratings | | Typical Operation | | | Type No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volts | Amperes | Nominal Face Dimensions in Inches | Length in Inches | Construction | Terminal | Face Plate Color | | | | | | | Anode Volts | Accelerator Grid Volts | Anode Volts | Accelerator Grid Volts | Control Grid Negative Volts | |
| 3HP7 | 6.3 | 0.6 | 3 Diam. | 9-13/16 | Glass | Snap | Clear | 55 | None | Medium Shell Octal 8 Pin | 5AN | None | Magnetic | 5000 | 200 | 4000<br>5000 | 150<br>150 | 15-45<br>15-45 | 3HP7 |
| 3NP4 | 6.3 | 0.6 | 2-9/16 Diam. | 10 | Glass | Recessed Small Ball | Clear | 42 | None | Special 5 Pin | 3NP4 | 275 Min, 375 Max. | Magnetic | 25000 | ... | 24000 | ... | 60 | 3NP4 |
| 5FP4A | 6.3 | 0.6 | 5 Diam. | 11-1/8 | Glass | Recessed Small Ball | Clear | 53 | None | Medium Shell Octal 8 Pin | 8BX | None | Magnetic | 8000 | 300 | 6000 | 250 | 45 | 5FP4A |
| 5FP7A | 6.3 | 0.6 | 5 Diam. | 11-1/2 | Glass | Recessed Small Ball | Clear | 53 | None | Medium Shell Octal 8 Pin | 8BX | None | Magnetic | 8000 | 700 | 4000<br>7000 | 250<br>250 | 25-70<br>25-70 | 5FP7A |
| 5FP7 | 6.3 | 0.6 | 5 Diam. | 11-1/8 | Glass | Snap | Clear | 55 | None | Small Wafer Octal 8 Pin with Sleeve | 5AN | None | Magnetic | 7000 | 300 | 4000<br>7000 | 250<br>250 | 25-75<br>25-75 | 5FP7 |
| 5FP14 | 6.3 | 0.6 | 5 Diam. | 11-1/8 | Glass | Snap | Clear | 55 | None | Small Wafer Octal 8 Pin with Sleeve | 5AN | None | Magnetic | 7000 | 700 | 4000<br>7000 | 250<br>250 | 25-75<br>25-75 | 5FP14 |
| 5TP4 | 6.3 | 0.6 | 5 Diam. | 11-3/4 | Glass | Recessed Small Cavity | Clear | 50 | None | Medium Shell Diheptal 12 Pin | 12C1 | 100 Min, 500 Max. | Note 2 | 27000 | 350 | 27000 | 200 | 70 | 5TP4 |
| 5WP15 | 6.3 | 0.6 | 5 Diam. | 11-7/16 | Glass | Recessed Small Cavity | Clear | 50 | None | Small Shell Duodecal 7 Pin | 12C1 | 100 Min, 500 Max. | Note 2 | 27000 | 350 | 20000 | 200 | 70 | 5WP15 |
| 7AP4 | 2.5 | 2.1 | 7-1/8 Diam. | 13-1/2 | Glass | None | Clear | 55 | None | Medium 5 Pin | 5AJ | None | Note 2 | 35000 | No Grid | 35000 | No Grid | 67.5 | 7AP4 |
| 7BP1 | 6.3 | 0.6 | 7 Diam. | 13-1/4 | Glass | Snap | Clear | 55 | None | Octal 8 Pin with Sleeve | 5AN | None | Magnetic | 7000 | 675 | 4000<br>7000 | 250<br>250 | 50<br>50 | 7BP1 |
| 7BP7 | 6.3 | 0.6 | 7 Diam. | 13-1/4 | Glass | Snap | Clear | 55 | None | Octal 8 Pin with Sleeve | 5AN | None | Magnetic | 7000 | 300 | 4000<br>7000 | 250<br>250 | 50<br>50 | 7BP7 |
| 7BP7A | 6.3 | 0.6 | 7 Diam. | 13-1/4 | Glass | Recessed Small Ball | Clear | 53 | None | Medium Shell Octal 8 Pin | 8BX | None | Magnetic | 8000 | 700 | 4000<br>7000 | 250<br>250 | 25-70<br>25-70 | 7BP7A |
| 7CP1 | 6.3 | 0.6 | 7 Diam. | 13-7/16 | Glass | Snap | Clear | 57 | None | Medium Shell Octal 8 Pin | 6AZ | None | Note 2 | 8000 | 300 | 4000<br>7000 | 250<br>250 | 45<br>45 | 7CP1 |
| 7CP4 | 6.3 | 0.6 | 7 Diam. | 13-7/16 | Glass | Recessed Small Ball | Clear | 57 | None | Medium Shell Octal 8 Pin | 6AZ | None | Note 2 | 8000 | 300 | 6000 | 250 | 45 | 7CP4 |
| 7DP4 | 6.3 | 0.6 | 7-3/16 Diam. | 14-1/16 | Glass | Recessed Small Cavity | Clear | 50 | Double | Small Shell Duodecal 7 Pin | 12C2 | 400 Min, 1500 Max. | Note 2 | 8000 | 410 | 6000 | 250 | 45 | 7DP4 |
| 7HP4 | 6.3 | 0.6 | 7-3/16 Diam. | 13 | Glass | Recessed Small Ball | Clear | 50 | None | Small Shell Duodecal 7 Pin | 12D2 | 500 Max. | Magnetic | 8000 | 410 | 6000 | 250 | 33-77 | 7HP4 |
| 8AP4 | 6.3 | 0.6 | 8-1/2 Diam. | 14-1/4 | Metal | Cone Lip | Clear | 54 | Single | Small Shell Duodecal 7 Pin | 12H | None | Magnetic | 10000 | No Grid | 9000 | No Grid | 27-63 | 8AP4 |
| 8AP4A | 6.3 | 0.6 | 8-1/2 Diam. | 14-1/4 | Metal | Cone Lip | Gray | 54 | Single | Small Shell Duodecal 5 Pin | 12H | None | Magnetic | 9000 | No Grid | 7000 | No Grid | 27-63 | 8AP4A |
| 9AP4 | 2.5 | 2.1 | 9-1/8 Diam. | 21 | Glass | Cap | Clear | 40 | None | Medium 6 Pin | 6AL | None | Note 2 | 7000 | 250 | 6000<br>7000 | 250<br>250 | 25<br>25 | 9AP4 |
| 9CP4 | 2.5 | 2.1 | 9 Diam. | 15-7/8 | Glass | Cap | Clear | ... | None | 6 Pin Base | 4AF | None | Magnetic | 7000 | No Grid | 6000<br>7000 | No Grid | 90<br>100 | 9CP4 |
| 9GP7 | 6.3 | 0.6 | 9 Diam. | 17 | Glass | Cap | Clear | 55 | None | Octal 8 Pin with Sleeve | 5AN | None | Magnetic | 7000 | 300 | 4000<br>7000 | 250<br>250 | 45<br>45 | 9GP7 |
| 9JP1 | 2.5 | 2.1 | 9 Diam. | 15-11/16 | Glass | Snap | Clear | 55 | None | Small Wafer Octal 8 Pin with Sleeve | 8BR | None | Note 3 | 5000 | No Grid | 2500<br>5000 | No Grid | 45<br>90 | 9JP1 |
| 9LP7 | 6.3 | 0.6 | 9 Diam. | 14-31/32 | Glass | Cap | Clear | 55 | None | Octal 8 Pin with Sleeve | 5AN | None | Magnetic | 7000 | 300 | 4000<br>4000<br>7000<br>7000 | 250<br>125<br>250<br>125 | 55-105<br>30-50<br>60-100<br>30-50 | 9LP7 |
| 9MP7 | 6.3 | 0.6 | 9 Diam. | 17-1/2 | Glass | Cap | Clear | ... | None | Octal 8 Pin with Sleeve | 5AN | None | Magnetic | 7000 | 300 | 4000<br>6000 | 250 | 25-75 | 9MP7 |
| 10BP4 | 6.3 | 0.6 | 10-1/2 Diam. | 17-5/8 | Glass | Recessed Small Cavity | Clear | 50 | Double | Small Shell Duodecal 7 Pin | 12D2 | 500 Min, 2500 Max. | Magnetic | 10000 | 410 | 9000 | 250 | 20-60 | 10BP4 |
| 10BP4A | | | | | | | Gray | | | | | | | | | | | | 10BP4A |
| 10CP4 | 6.3 | 0.6 | 10-1/2 Diam. | 16-5/8 | Glass | Recessed Small Ball | Clear | 50 | None | Small Shell Duodecal 7 Pin | 12D2 | 500 Max. | Magnetic | 11000 | 410 | 8000 | 250 | 30-66 | 10CP4 |

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## MAGNETIC TYPE CATHODE RAY TUBES

| Type No. | Heater | | Bulb | | | | | | Ion Trap Required | Base | RMA Basing | μμf Filter Capacitance Provided by Bulb Coating | Deflection and Focusing Method | Maximum Design Center Ratings | | Typical Operation | | | Type No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volts | Amperes | Nominal Face Dimensions in Inches | Length in Inches | Construction | Terminal | Face Plate Color | Deflection Angle in Degrees (Note 1) | | | | | | Anode Volts | Accelerator Grid Volts | Anode Volts | Accelerator Grid Volts | Control Grid Negative Volts | |
| 10DP4 | 6.3 | 0.6 | 10-1/2 Diam. | 17-5/8 | Glass | Recessed Small Cavity | Clear | 50 | None | Small Shell Duodecal 7 Pin | 12C3 | None | Note 2 | 10000 | 410 | 9000 | 250 | 36-84 | 10DP4 |
| 10EP4 | 6.3 | 0.6 | 10-1/2 Diam. | 17-5/8 | Glass | Snap | Clear | 50 | Double | Small Shell Duodecal 7 Pin | 12D2 | .... | Magnetic | 11000 | 330 | 8000 | 250 | 20-65 | 10EP4 |
| 10FP4 | 6.3 | 0.6 | 10-1/2 Diam. | 17-5/8 | Glass | Recessed Small Cavity | Clear | 50 | None | Small Shell Duodecal 7 Pin | 12C1 | 500 Min, 2500 Max. | Magnetic | 10000 | 410 | 9000 | 250 | 27-63 | 10FP4 |
| 10KP7 | 6.3 | 0.6 | 10-1/2 Diam. | 17-5/8 | Glass | Recessed Small Cavity | Clear | 50 | None | Small Shell Duodecal 7 Pin | 12D1 | None | Magnetic | 10000 | 700 | 7000<br>9000 | 250<br>250 | 27-63<br>27-63 | 10KP7 |
| 10MP4 | 6.3 | 0.6 | 10-1/2 Diam. | 17 | Glass | Recessed Small Cavity | Clear | 52 | Double | Small Shell Duodecal 5 Pin | 12G | 500 Min, 2500 Max. | Magnetic | 10000 | No Grid | 9000 | No Grid | 27-63 | 10MP4 |
| 10MP4A | | | | | | | Gray | | | | | | | | | | | | 10MP4A |
| 12AP4 | 2.5 | 2.1 | 12-1/16 Diam. | 25-3/8 | Glass | Cap | Clear | 40 | None | Medium 6 Pin | 6AL | None | Note 2 | 7000 | 250 | 6000<br>7000 | 250<br>250 | 75<br>75 | 12AP4 |
| 12CP4 | 2.5 | 2.1 | 12-1/16 Diam. | 18-5/8 | Glass | Cap | Clear | ... | None | 6 Pin Base | 4AF | None | Magnetic | 7000 | No Grid | 6000<br>7000 | No Grid | 90<br>110 | 12CP4 |
| 12DP7 | 6.3 | 0.6 | 12 Diam. | 20-3/4 | Glass | Medium Cap | Clear | 55 | None | Small Wafer Octal 8 Pin with Sleeve | 5AN | None | Magnetic | 7000 | 300 | 4000<br>7000 | 250<br>250 | 25-75<br>25-75 | 12DP7 |
| 12DP7A | 6.3 | 0.6 | 12 Diam. | 19-5/8 | Glass | Medium Cap | Clear | 50 | None | Medium Shell Octal 8 Pin | 8RX | None | Magnetic | 10000 | 700 | 4000<br>7000 | 250<br>250 | 25-70<br>25-70 | 12DP7A |
| 12JP4 | 6.3 | 0.6 | 12 Diam. | 17-1/2 | Glass | Snap | Clear | 50 | None | Small Shell Duodecal 7 Pin | 12D1 | None | Magnetic | 12000 | 410 | 10000 | 250 | 27-63 | 12JP4 |
| 12KP4 | 6.3 | 0.6 | 12-7/16 Diam. | 17-5/8 | Glass | Recessed Small Cavity | Clear | 54 | None | Small Shell Duodecal 7 Pin | 12D2 | 500 Min, 2500 Max. | Magnetic | 12000 | 410 | 10000 | 250 | 27-63 | 12KP4 |
| 12KP4A | 6.3 | 0.6 | 12-7/16 Diam. | 17-5/8 | Glass | Recessed Small Cavity | Gray | 54 | None | Small Shell Duodecal 5 Pin | 12D2 | 500 Min, 2500 Max. | Magnetic | 12000 | 410 | 11000 | 250 | 27-63 | 12KP4A |
| 12LP4 | 6.3 | 0.6 | 12-7/16 Diam. | 18-3/4 | Glass | Recessed Small Cavity | Clear | 54 | Double | Small Shell Duodecal 5 Pin | 12D2 | 750 Min, 3000 Max. | Magnetic | 12000 | 410 | 11000 | 250 | 27-63 | 12LP4 |
| 12LP4A | | | | | | | Gray | | | | | | | | | | | | 12LP4A |
| 12QP4 | 6.3 | 0.6 | 12-7/16 Diam. | 17-1/2 | Glass | Recessed Small Ball Cap | Clear | 55 | Single | Small Shell Duodecal 7 Pin | 12D1 | None | Magnetic | 12000 | 410 | 10000 | 250 | 27-63 | 12QP4 |
| 12QP4A | | | | | | | Gray | | | | | | | | | | | | 12QP4A |
| 12RP4 | 6.3 | 0.6 | 12 Diam. | 17-1/2 | Glass | Recessed Small Ball Cap | Clear | 56 | Single | Small Shell Duodecal 7 Pin | 12D2 | .... | Magnetic | 12000 | 410 | 10000 | 250 | 27-63 | 12RP4 |
| 12SP7 | 6.3 | 0.6 | 12-7/16 Diam. | 18-3/4 | Glass | Recessed Small Cavity | Clear | 55 | None | Small Shell Duodecal 7 Pin | 12D1 | None | Magnetic | 10000 | 410 | 9000 | 250 | 27-63 | 12SP7 |
| 12TP4 | 6.3 | 0.6 | 12-7/16 Diam. | 18-3/4 | Glass | Recessed Small Cavity | Clear | 54 | Double | Small Shell Duodecal 7 Pin | 12D1 | None | Magnetic | 12000 | 410 | 11000 | 250 | 27-63 | 12TP4 |
| 12UP4 | 6.3 | 0.6 | 12-7/16 Diam. | 18-5/8 | Metal | Cone Lip | Clear | 54 | Double | Small Shell Duodecal 7 Pin | 12D3 | None | Magnetic | 12000 | 410 | 11000 | 250 | 27-63 | 12UP4 |
| 12UP4A | | | | | | | Gray | | | | | | | | | | | | 12UP4A |
| 12UP4B | | | | | | | Gray | | | | | | | | | | | | 12UP4B |
| 12VP4 | 6.3 | 0.6 | 12-3/8 Diam. | 18 | Glass | Recessed Small Cavity | Clear | 55 | Double | Small Shell Duodecal 5 Pin | 12G | 750 Min, 3000 Max. | Magnetic | 12000 | No Grid | 11000 | No Grid | 33-77 | 12VP4 |
| 12VP4A | | | | | | | Gray | | | | | | | | | | | | 12VP4A |
| 14BP4 | 6.3 | 0.6 | 12-1/2 x 9-11/16 | 16-13/16 | Glass | Recessed Small Cavity | Gray | 65 | Double | Small Shell Duodecal 5 Pin | 12D2 | 500 Min, 2000 Max. | Magnetic | 12000 | 410 | 11000 | 250 | 27-63 | 14BP4 |
| 14CP4 | 6.3 | 0.6 | 12-1/2 x 9-11/16 | 16-3/4 | Glass | Recessed Small Cavity | Gray | 65 | Double | Small Shell Duodecal 5 Pin | 12D2 | 1500 | Magnetic | 14000 | 410 | 12000 | 300 | 33-77 | 14CP4 |
| 14DP4 | 6.3 | 0.6 | 12-1/2 x 9-11/16 | 16-3/4 | Glass | Recessed Small Cavity | Gray | 65 | Double | Small Shell Duodecal 5 Pin | 12D1 | None | Magnetic | 14000 | 410 | 11000 | 250 | 27-63 | 14DP4 |
| 15AP4 | 6.3 | 0.6 | 15-1/2 Diam. | 20-1/2 | Glass | Recessed Small Ball | Clear | 52 | None | Small Shell Duodecal 7 Pin | 12G | None | Magnetic | 15000 | 410 | 12000 | 250 | 27-63 | 15AP4 |
| 15CP4 | 6.3 | 0.6 | 15-1/2 Diam. | 21-1/2 | Glass | Recessed Small Cavity | Clear | 57 | Double | Small Shell Duodecal 7 Pin | 12D1 | None | Magnetic | 15000 | 410 | 9000<br>15000 | 250 + | 45 | 15CP4 |

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## MAGNETIC TYPE CATHODE RAY TUBES

| Type No. | Heater | | Bulb | | | | | Deflection Angle in Degrees (Note 1) | Ion Trap Required | Base | RMA Basing | μμf Filter Capacitance Provided by Bulb Coating | Deflection and Focusing Method | Maximum Design Center Ratings | | Typical Operation | | | Type No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volts | Amperes | Nominal Face Dimensions in Inches | Length in Inches | Construction | Terminal | Face Plate Color | | | | | | | Anode Volts | Accelerator Grid Volts | Anode Volts | Accelerator Grid Volts | Control Grid Negative Volts | |
| 15DP4 | 6.3 | 0.6 | 15-1/2 Diam. | 20-1/2 | Glass | Recessed Small Ball Cap | Clear | 57 | Double | Small Shell Duodecal 5 Pin | 12D1 | None | Magnetic | 15000 | 410 | 13000 | 250 | 27-63 | 15DP4 |
| 16AP4 | 6.3 | 0.6 | 15-7/8 Diam. | 22-5/16 | Metal | Cone Lip | Clear | 53 | Double | Small Shell Duodecal 5 Pin | 12D3 | None | Magnetic | 14000 | 410 | 9000<br>12000 | 300<br>300 | 33-77<br>33-77 | 16AP4 |
| 16AP4A | | | | | | | Gray | | | | | | | | | | | | 16AP4A |
| 16CP4 | 6.3 | 0.6 | 15-7/8 Diam. | 21-1/2 | Glass | Recessed Small Cavity | Clear | 52 | Double | Small Shell Duodecal 7 Pin | 12D1 | None | Magnetic | 15000 | 410 | 12000 | 250 | 27-63 | 16CP4 |
| 16DP4 | 6.3 | 0.6 | 15-7/8 Diam. | 20-3/4 | Glass | Recessed Small Cavity | Clear | 60 | Double | Small Shell Duodecal 7 Pin | 12D1 | None | Magnetic | 15000 | 410 | 9000<br>12000 | 250 | 45 | 16DP4 |
| 16DP4A | | | | | | | Gray | | | | | | | | | | | | 16DP4A |
| 16FP4 | 6.3 | 0.6 | 15-7/8 Diam. | 19-5/8 | Metal | Cone Lip | Clear | 60 | Double | Small Shell Duodecal 5 Pin | 12D3 | None | Magnetic | 14000 | 410 | 12000 | 300 | 33-77 | 16EP4 |
| 16FP4A | | | | | | | Gray | | | | | | | | | | | | 16EP4A |
| 16FP4 | 6.3 | 0.6 | 16-1/8 Diam. | 20-1/4 | Glass | Recessed Small Ball Cap | Clear | 62 | Single | Small Shell Duodecal 7 Pin | 12D1 | None | Magnetic | 16000 | 410 | 13000 | 250 | 27-63 | 16FP4 |
| 16GP4 | 6.3 | 0.6 | 15-7/8 Diam. | 17-11/16 | Metal | Cone Lip | Clear | 70 | Single | Small Shell Duodecal 5 Pin | 12D3 | None | Magnetic | 14000 | 410 | 12000 | 300 | 33-77 | 16GP4 |
| 16HP4 | 6.3 | 0.6 | 15-7/8 Diam. | 21-1/4 | Glass | Recessed Small Cavity | Clear | 60 | Double | Small Shell Duodecal 5 Pin | 12D2 | 1500 Min, 3500 Max. | Magnetic | 14000 | 410 | 12000 | 300 | 33-77 | 16HP4 |
| 16HP4A | | | | | | | Gray | | | | | | | | | | | | 16HP4A |
| 16JP4 | 6.3 | 0.6 | 16-1/8 Diam. | 20-3/4 | Glass | Recessed Small Cavity | Clear | 60 | Double | Small Shell Duodecal 5 Pin | 12D2 | 750 Min, 2000 Max. | Magnetic | 14000 | 410 | 11000 | 250 | 27-63 | 16JP4 |
| 16JP4A | | | | | | | Gray | | | | | | | | | | | | 16JP4A |
| 16KP4 | 6.3 | 0.6 | 14-3/4 x 11-1/2 | 18-3/4 | Glass | Recessed Small Cavity | Clear | 65 | Single | Small Shell Duodecal 5 Pin | 12D2 | 1500 | Magnetic | 16000 | 410 | 14000 | 300 | 33-77 | 16KP4 |
| 16LP4 | 6.3 | 0.6 | 15-7/8 Diam. | 22-1/4 | Glass | Recessed Small Cavity | Clear | 52 | Double | Small Shell Duodecal 5 Pin | 12D2 | 1500 Min, 3500 Max. | Magnetic | 14000 | 410 | 12000 | 300 | 33-77 | 16LP4 |
| 16LP4A | | | | | | | Gray | | | | | | | | | | | | 16LP4A |
| 16MP4 | 6.3 | 0.6 | 16-1/8 Diam. | 21-3/4 | Glass | Recessed Small Cavity | Clear | 60 | Double | Small Shell Duodecal 5 Pin | 12D2 | 1500 Min, 3500 Max. | Magnetic | 14000 | 410 | 12000 | 300 | 33-77 | 16MP4 |
| 16MP4A | | | | | | | Gray | | | | | | | | | | | | 16MP4A |
| 16QP4 | 6.3 | 0.6 | 14-3/4 x 11-17/32 | 19.146 | Glass | Recessed Small Cavity | Gray | 65 | Double | Small Shell Duodecal 7 Pin | 12D1 | None | Magnetic | 16000 | 410 | 8000<br>14000 | 250<br>250 | 27-63 | 16QP4 |
| 16RP4 | 6.3 | 0.6 | 14-3/4 x 11-1/2 | 18-3/4 | Glass | Recessed Small Cavity | Gray | 65 | Single | Small Shell Duodecal 5 Pin | 12D2 | 1500 | Magnetic | 16000 | 410 | 12000 | 300 | 33-77 | 16RP4 |
| 16SP4 | 6.3 | 0.6 | 15-7/8 Diam. | 17-5/16 | Glass | Recessed Small Cavity | Clear | 70 | Double | Small Shell Duodecal 5 Pin | 12D2 | 1500 Min, 3500 Max. | Magnetic | 14000 | 410 | 12000 | 300 | 33-77 | 16SP4 |
| 16SP4A | | | | | | | Gray | | | | | | | | | | | | 16SP4A |
| 16TP4 | 6.3 | 0.6 | 16-1/8 Diam. | 18-1/8 | Glass | Recessed Small Cavity | Gray | 70 | Single | Small Shell Duodecal 5 Pin | 12D2 | 1500 | Magnetic | 14000 | 410 | 12000 | 300 | 33-77 | 16TP4 |
| 16UP4 | 6.3 | 0.6 | 14-3/4 x 11-1/2 | 18-1/8 | Glass | Recessed Small Cavity | Gray | 65 | Single | Small Shell Duodecal 5 Pin | 12D1 | None | Magnetic | 15000 | 410 | 12000 | 300 | 27-63 | 16UP4 |
| 16VP4 | 6.3 | 0.6 | 15-7/8 Diam. | 17-3/16 | Glass | Recessed Small Cavity | Gray | 70 | Single | Small Shell Duodecal 5 Pin | 12D1 | None | Magnetic | 15000 | 410 | 12000 | 250 | 27-63 | 16VP4 |
| 16WP4 | 6.3 | 0.6 | 15-7/8 Diam. | 17-3/4 | Glass | Recessed Small Cavity | Gray | 70 | Double | Small Shell Duodecal 5 Pin | 12D1 | None | Magnetic | 15000 | 410 | 12000 | 250 | 27-63 | 16WP4 |
| 16XP4 | 6.3 | 0.6 | 14-3/4 x 11-17/32 | 18-3/4 | Glass | Recessed Small Cavity | Gray | 65 | Double | Small Shell Duodecal 5 Pin | 12D1 | None | Magnetic | 15000 | 410 | 12000 | 250 | 27-63 | 16XP4 |
| 16YP4 | 6.3 | 0.6 | 15-7/8 Diam. | 17-5/16 | Glass | Recessed Small Cavity | Gray | 70 | Single | Small Shell Duodecal 5 Pin | 12D2 | 750 Min, 2000 Max. | Magnetic | 14000 | 410 | 12000 | 300 | 33-77 | 16YP4 |
| 19AP4 | 6.3 | 0.6 | 18-5/8 Diam. | 21-1/2 | Metal | Cone Lip | Clear | 66 | Single | Small Shell Duodecal 7 Pin | 12D3 | None | Magnetic | 19000 | 410 | 13000 | 250 | 27-63 | 19AP4 |
| 19AP4A | | | | | | | Gray | | | | | | | | | | | | 19AP4A |

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## MAGNETIC TYPE CATHODE RAY TUBES

| Type No. | Heater | | Bulb | | | | | Ion Trap Required | Base | RMA Basing | μμf Filter Capacitance Provided by Bulb Coating | Deflection and Focusing Method | Maximum Design Center Ratings | | Typical Operation | | | Type No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volts | Amperes | Nominal Face Dimensions in Inches | Length in Inches | Construction | Terminal | Face Plate Color | Deflection Angle in Degrees (Note 1) | | | | | | Anode Volts | Accelerator Grid Volts | Anode Volts | Accelerator Grid Volts | Control Grid Negative Volts | |
| 19DP4 | 6.3 | 0.6 | 18-7/8 Diam. | 21-1/2 | Glass | Recessed Small Cavity | Clear | 66 | Double | Small Shell Duodecal 5 Pin | 12D2 | 1000 Min, 3000 Max. | Magnetic | 19000 | 410 | 13000 | 250 | 26-63 | 19DP4 |
| 19FP4 | 6.3 | 0.6 | 18-7/8 Diam. | 22 | Glass | Recessed Small Cavity | Gray | 66 | Double | Small Shell Duodecal 5 Pin | 12D1 | None | Magnetic | 19000 | 410 | 13000 | 250 | 27-63 | 19FP4 |
| 19GP4 | 6.3 | 0.6 | 18-7/8 Diam. | 21-1/4 | Glass | Recessed Small Cavity | Gray | 66 | Single | Small Shell Duodecal 5 Pin | 12D1 | None | Magnetic | 19000 | 410 | 13000 | 250 | 27-63 | 19GP4 |
| 20BP4 | 6.3 | 0.6 | 20 Diam. | 28-3/4 | Glass | Medium Cap | Clear | 54 | None | Small Shell Duodecal 7 Pin | 12D1 | None | Magnetic | 16500 | 750 | 10000<br>15000 | 250<br>250 | 25-70<br>25-70 | 20BP4 |
| 22AP4 | 6.3 | 0.6 | 21-11/16 Diam. | 22-7/8 | Metal | (Cone Lip) | Clear | 70 | Single | Small Shell Duodecal 5 Pin | 12D3 | None | Magnetic | 19000 | 410 | 14000 | 300 | 33-77 | 22AP4 |
| 22AP4A | | | | | | | Gray | | | | | | | | | | | | 22AP4A |
| 904 | 2.5 | 2.1 | 5-1/16 Diam. | 16-1/4 | Glass | Cap | Clear | ... | None | Medium 6 Pin | 6AL | None | Note 4 | 4600 | 250 | 1000<br>3000<br>4600 | 100<br>100<br>250 | 34<br>35<br>39 | 904 |
| 5WP11 | 6.3 | 0.6 | 5 Diam. | 11-7/16 | Glass | Recessed Small Cavity | Clear | 50 | None | Small Shell Duodecal 7 Pin | 12C2 | 100 Min, 500 Max. | Note 2 | 27000 | 350 | 27000 | 200 | 42-98 | 5WP11 |
| 7MP7 | 6.3 | 0.6 | 7-3/16 Diam. | 12-1/2 | Glass | Recessed Small Cavity | Clear | 50 | None | Small Shell Duodecal 5 Pin | 12D1 | None | Magnetic | 8000 | 700 | 4000<br>7000 | 250<br>250 | 27-63<br>27-63 | 7MP7 |
| 19EP4 | 6.3 | 0.6 | 17 x 13-3/32 | 21-1/8 | Glass | Recessed Small Cavity | Gray | 65 | Single | Small Shell Duodecal 5 Pin | 12D2 | 1000 Min, 2500 Max. | Magnetic | 19000 | 410 | 13000 | 250 | 26-63 | 19EP4 |
| 16ZP4 | 6.3 | 0.6 | 15-7/8 Diam. | 22-1/4 | Glass | Recessed Small Cavity | Gray | 52 | Single | Small Shell Duodecal 5 Pin | 12D2 | 750 Min, 2000 Max. | Magnetic | 16000 | 410 | 12000 | 300 | 33-77 | 16ZP4 |
| 16WP4A | 6.3 | 0.6 | 15-7/8 Diam. | 17-3/4 | Glass | Recessed Small Cavity | Gray | 70 | Single | Small Shell Duodecal 5 Pin | 12D2 | 750 Min, 2000 Max. | Magnetic | 16000 | 410 | 12000 | 250 | 27-63 | 16WP4A |
| 17AP4 | 6.3 | 0.6 | 15-3/8 x 12-1/4 | 18-5/8 | Glass | Recessed Small Cavity | Gray | 65 | Single | Small Shell Duodecal 5 Pin | 12D2 | 750 Min, 2000 Max. | Magnetic | 16000 | 410 | 12000 | 300 | 33-77 | 17AP4 |
| 17BP4 | 6.3 | 0.6 | 15-25/64 x 12-9/64 | 19-5/8 | Glass | Recessed Small Cavity | Clear | 65 | Single | Small Shell Duodecal 5 Pin | 12D2 | 750 Min, 2000 Max. | Magnetic | 16000 | 410 | 12000 | 300 | 33-77 | 17BP4 |
| 17BP4A | | | | | | | Gray | | | | | | | | | | | | 17BP4A |
| 10FP4A | 6.3 | 0.6 | 10-1/2 Diam. | 17-5/8 | Glass | Recessed Small Cavity | Gray | 54 | None | Small Shell Duodecal 5 Pin | 12D2 | 500 Min, 2500 Max. | Magnetic | 12000 | 410 | 11000 | 250 | 27-63 | 10FP4A |

Note 1: Horizontal Deflection Angles are given for Rectangular Tubes.

Note 2: Magnetic Deflection, Electrostatic Focusing.

Note 3: Electrostatic and Magnetic Deflection, Magnetic Focusing.

Note 4: Electrostatic and Magnetic Deflection, Electrostatic Focusing.

*Courtesy Sylvania Electric Products Inc.*

## CROSS INDEX OF ARMY VT NUMBERS AND COMMERCIAL NUMBERS

| VT NUMBER | COMMERCIAL NUMBER |
|---|---|
| VT-1 | WE-203A (obsolete) |
| VT-2 | WE-205B |
| VT-3 | Obsolete. |
| VT-4A | Obsolete. |
| VT-4B | Commercial 211. |
| VT-4C | JAN 211. |
| VT-5 | WE-215A |
| VT-6 | 212A (obsolete) |
| VT-7 | WX-12 (obsolete) |
| VT-8 | UV-204 (obsolete) |
| VT-10 | Obsolete. |
| VT-11 | Obsolete. |
| VT-12 | Obsolete. |
| VT-13 | Obsolete. |
| VT-14 | Obsolete. |
| VT-16 | Obsolete. |
| VT-17 | 860. |
| VT-18 | Obsolete. |
| VT-19 | 861. |
| VT-20 | Obsolete. |
| VT-21 | Obsolete. |
| VT-22 | 204A. |
| VT-23 | Obsolete. |
| VT-24 | 864. |
| VT-25 | 10. |
| VT-25A | 10 Special. |
| VT-26 | 22. |
| VT-27 | 30. |
| VT-28 | 24, 24A. |
| VT-29 | 27. |
| VT-30 | 01-A |
| VT-31 | 31. |
| VT-32 | Obsolete. |
| VT-33 | 33. |
| VT-34 | 207. |
| VT-35 | 35/51. |
| VT-36 | 36. |
| VT-37 | 37. |
| VT-38 | 38. |
| VT-39 | 869. |
| VT-39A | 869A |
| VT-40 | 40. |
| VT-41 | 851. |
| VT-42 | 872. |
| VT-42A | 872A (Special fil.). |
| VT-43 | 845. |
| VT-44 | 32. |
| VT-45 | 45. |
| VT-46 | 866. |
| VT-46A | 866A. |
| VT-47 | 47. |
| VT-48 | 41. |
| VT-49 | 39/44. |
| VT-50 | 50. |
| VT-51 | 841. |
| VT-52 | 45 Special. |
| VT-53 | Canceled (superseded by VT-42A). |
| VT-54 | 34. |
| VT-55 | 865. |
| VT-56 | 56. |
| VT-57 | 57. |
| VT-58 | 58. |
| VT-60 | 850. |
| VT-62 | 801,801A. |
| VT-63 | 46. |
| VT-64 | 800. |
| VT-65 | 6C5. |
| VT-65A | 6C5G. |
| VT-66 | 6F6. |
| VT-66A | 6F6G. |
| VT-67 | 30 Special. |
| VT-68 | 6B7. |
| VT-69 | 6D6. |
| VT-70 | 6F7. |
| VT-72 | 842. |
| VT-73 | 843. |
| VT-74 | 5Z4. |
| VT-75 | 75. |
| VT-76 | 76. |
| VT-77 | 77. |
| VT-78 | 78. |
| VT-80 | 80. |
| VT-83 | 83. |
| VT-84 | 84/6Z4. |
| VT-86 | 6K7. |
| VT-86A | 6K7G. |
| VT-86B | 6K7GT. |
| VT-87 | 6L7. |
| VT-87A | 6L7G. |
| VT-88 | 6R7. |
| VT-88A | 6R7G. |
| VT-88B | 6R7GT. |
| VT-89 | 89 |
| VT-90 | 6H6. |
| VT-90A | 6H6GT. |
| VT-91 | 6J7. |
| VT-91A | 6J7GT. |
| VT-92 | 6Q7. |
| VT-92A* | 6Q7G. |
| VT-93 | 6B8. |
| VT-93A | 6B8G. |
| VT-94 | 6J5. |
| VT-94A | 6J5G. |
| VT-94B | 6J5 Special selec. |
| VT-94C | 6J5G Special selec. |
| VT-94D | 6J5GT. |
| VT-95 | 2A3. |
| VT-96 | 6N7. |
| VT-96B | 6N7 Special selec. |
| VT-97 | 5W4. |
| VT-98 | 6U5/6G5. |
| VT-99 | 6F8G. |
| VT-100 | 807. |
| VT-100A | 807 Modified. |
| VT-101 | 837. |
| VT-102 | Canceled. |
| VT-103 | 6SQ7. |
| VT-104 | 12SQ7. |
| VT-105 | 6SC7. |
| VT-106 | 803. |
| VT-107 | 6V6. |
| VT-107A | 6V6GT. |
| VT-107B | 6V6G. |
| VT-108 | 450TH. |
| VT-109 | 2051. |
| VT-111 | 5BP4/1802P4. |
| VT-112 | 6AC7/1852. |
| VT-114 | 5T4. |
| VT-115 | 6L6. |
| VT-115A | 6L6G. |
| VT-116 | 6SJ7. |
| VT-116A | 6SJ7GT. |
| VT-116B | 6SJ7Y. |
| VT-117 | 6SK7. |
| VT-117A | 6SK7GT. |
| VT-118 | 832. |
| VT-119 | 2X2/879. |
| VT-120 | 954. |
| VT-121 | 955. |
| VT-122 | 530. |
| VT-123 | RCA A-5586 (superseded by VT-128). |
| VT-124 | 1A5GT. |
| VT-125 | 1C5GT. |
| VT-126 | 6X5. |
| VT-126A | 6X5G. |
| VT-126B | 6X5GT. |
| VT-127 | Special tube. |
| VT-127A | Special tube. |
| VT-128 | 1630 (A-5588). |
| VT-129 | 304TL. |
| VT-130 | 250TL. |
| VT-131 | 12SK7. |
| VT-132 | 12K8 Special. |
| VT-133 | 12SR7 |
| VT-134 | 12A6. |
| VT-135 | 12J5GT. |
| VT-135A | 12J5. |
| VT-136 | 1625. |
| VT-137 | 1626. |
| VT-138 | 1629. |
| VT-139 | VR150-30. |
| VT-140* | 1628. |
| VT-141 | 531. |
| VT-142 | WE-39DY1. |
| VT-143 | 805. |
| VT-144 | 813. |

* Indicates VT number has been canceled.

| VT NUMBER | COMMERCIAL NUMBER |
|---|---|
| VT-145. . . . | 5Z3. |
| VT-146. . . . | 1N5GT. |
| VT-147. . . . | 1A7GT. |
| VT-148. . . . | 1D8GT. |
| VT-149. . . . | 3A8GT. |
| VT-150. . . . | 6SA7. |
| VT-150A. . . | 6SA7GT. |
| VT-151. . . . | 6A8G. |
| VT-151B. . . | 6A8GT. |
| VT-152. . . . | 6K6GT. |
| VT-152A. . . | 6K6G. |
| VT-153. . . . | 12C8 Special. |
| VT-154. . . . | 814. |
| VT-155. . . . | Special tube. |
| VT-156. . . . | Special tube. |
| VT-157. . . . | Special tube. |
| VT-158. . . . | Special tube. |
| VT-159. . . . | Special tube. |
| VT-160. . . . | Special tube. |
| VT-161. . . . | 12SA7. |
| VT-162. . . . | 12SJ7. |
| VT-163. . . . | 6C8G. |
| VT-164. . . . | 1619. |
| VT-165. . . . | 1624. |
| VT-166. . . . | 371A. |
| VT-167. . . . | 6K8. |
| VT-167A. . . | 6K8G. |
| VT-168A. . . | 6Y6G. |
| VT-169. . . . | 12C8. |
| VT-170. . . . | 1E5-GP. |
| VT-171. . . . | 1R5. |
| VT-171A. . . | Loctal Equiv. of 1R5. |
| VT-172. . . . | 1S5. |
| VT-173. . . . | 1T4. |
| VT-174. . . . | 3S4. |
| VT-175. . . . | 1613. |
| VT-176. . . . | 6AB7/1853. |
| VT-177. . . . | 1LH4. |
| VT-178. . . . | 1LC6. |
| VT-179. . . . | 1LN5. |
| VT-180*. . . | 3LF4. |
| VT-181. . . . | 7Z4. |
| VT-182. . . . | 3B7/1291. |
| VT-183. . . . | 1R4/1294. |
| VT-184. . . . | VR90-30. |
| VT-185. . . . | 3D6/1299. |
| VT-186. . . . | Special tube. |
| VT-187. . . . | 575A. |
| VT-188. . . . | 7E6. |
| VT-189. . . . | 7F7. |
| VT-190. . . . | 7H7. |
| VT-191. . . . | 316A. |
| VT-192. . . . | 7A4. |
| VT-193. . . . | 7C7. |
| VT-194. . . . | 7J7. |
| VT-195. . . . | 1005. |
| VT-196. . . . | 6W5G. |
| VT-197A. . . | 5Y3GT/G. |
| VT-198A. . . | 6G6G. |
| VT-199. . . . | 6SS7. |
| VT-200. . . . | VR-105-30. |
| VT-201. . . . | 25L6. |
| VT-201C. . . | 25L6GT. |
| VT-202. . . . | 9002. |
| VT-203. . . . | 9003. |
| VT-204. . . . | HK24G. |
| VT-205. . . . | 6ST7. |
| VT-206A. . . | 5V4G. |
| VT-207. . . . | 12AH7GT. |
| VT-208. . . . | 7B8. |
| VT-209. . . . | 12SG7. |
| VT-210. . . . | 1S4. |
| VT-211. . . . | 6SG7. |
| VT-212. . . . | 958. |
| VT-213A. . . | 6L5G. |
| VT-214. . . . | 12H6. |
| VT-215. . . . | 6E5. |
| VT-216. . . . | 816. |
| VT-217. . . . | 811. |
| VT-218. . . . | 100TH. |
| VT-219. . . . | Canceled. |
| VT-220. . . . | 250TH. |
| VT-221. . . . | 3Q5GT. |
| VT-222. . . . | 884. |
| VT-223. . . . | 1H5GT. |
| VT-224. . . . | RK-34. |
| VT-225. . . . | 307A. |
| VT-226. . . . | 3EP1/1806P1. |
| VT-227. . . . | 7184. |
| VT-228. . . . | 8012. |
| VT-229. . . . | 6SL7GT. |
| VT-230. . . . | 350A. |
| VT-231. . . . | 6SN7GT. |
| VT-232. . . . | E-1148. |
| VT-233. . . . | 6SR7. |
| VT-234. . . . | HY-114B. |
| VT-235. . . . | HY-615 |
| VT-236. . . . | 836. |
| VT-237. . . . | 957. |
| VT-238. . . . | 956. |
| VT-239. . . . | 1LE3. |
| VT-240. . . . | 710A. |
| VT-241. . . . | 7E5/1201. |
| VT-243. . . . | 7C4/1203A. |
| VT-244. . . . | 5U4G. |
| VT-245. . . . | 2050. |
| VT-246. . . . | 918. |
| VT-247. . . . | 6AG7. |
| VT-248. . . . | 1808P1. |
| VT-249. . . . | 1006. |
| VT-250. . . . | EF50. |
| VT-251. . . . | 441. |
| VT-252. . . . | 923. |
| VT-254. . . . | 304TH. |
| VT-255. . . . | 705A. |
| VT-256. . . . | ZP486. |
| VT-257. . . . | K-7. |
| VT-259. . . . | 829. |
| VT-260. . . . | VR75-30. |
| VT-264. . . . | 3Q4. |
| VT-266. . . . | 1616. |
| VT-267. . . . | 578. |
| VT-268. . . . | 12SC7. |
| VT-269. . . . | 717A. |
| VT-277. . . . | 417. |
| VT-279. . . . | GY-2. |
| VT-280*. . . | C7063. |
| VT-281*. . . | HY-145ZT. |
| VT-282. . . . | ZG489. |
| VT-283*. . . | QF-206. |
| VT-284*. . . | QF-197. |
| VT-285*. . . | QF-200C. |
| VT-286. . . . | 832A. |
| VT-287. . . . | 815. |
| VT-288. . . . | 12SH7. |
| VT-289. . . . | 12SL7GT. |

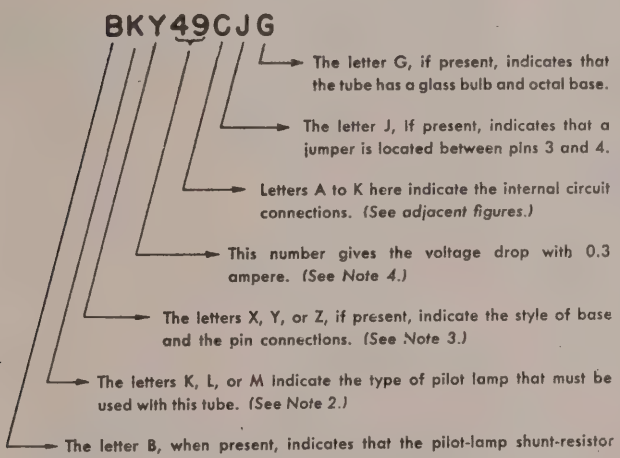
* Indicates VT number has been canceled.

# BALLAST TUBE AND RESISTOR NUMBERING CODES

## FOR AC-DC RECEIVERS USING 0.3 AMP. SERIES CONNECTED HEATERS

There are two numbering codes now in use for ballast and resistor tubes. Both codes use parts of the type designation to indicate the various divisions of the tube's service. For example, type numbers in the first system (A) might be BKX51DJ or L55B and, in the second system (B), might be 200R44 or 200R. These letter and number combinations are explained by the following examples.

### SYSTEM A


BKY49CJG
The letter G, if present, indicates that the tube has a glass bulb and octal base.
The letter J, if present, indicates that a jumper is located between pins 3 and 4.
Letters A to K here indicate the internal circuit connections. (See adjacent figures.)
This number gives the voltage drop with 0.3 ampere. (See Note 4.)
The letters X, Y, or Z, if present, indicate the style of base and the pin connections. (See Note 3.)
The letters K, L, or M indicate the type of pilot lamp that must be used with this tube. (See Note 2.)
The letter B, when present, indicates that the pilot-lamp shunt-resistor is a ballast type. (See Note 1.)

NOTE 1.

"Ballast" action indicates that the pilot lamp shunt resistor has low starting resistance when cold, protecting the lamp filament from the initial current surge, and has much higher resistance when hot, applying full operating voltage to the lamp.

NOTE 2.

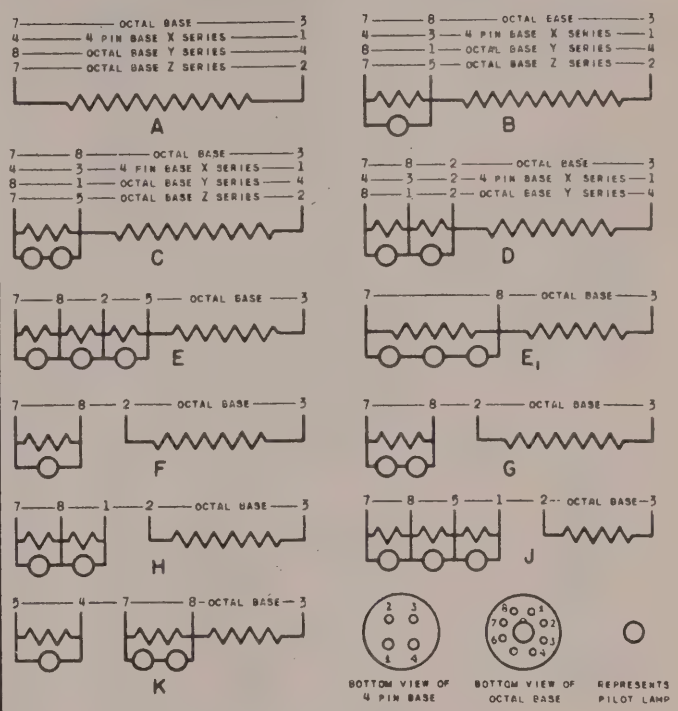
| Tube Letter | Lamp No. | Volts | Amperes | Bead Color |
|---|---|---|---|---|
| K | 40 and 47 | 6.3 | 0.15 | Brown |
| L | 44 and 46 | 6.3 | 0.25 | Blue |
| M | 50 and 51 | 7.5 | 0.2 | White |

NOTE 3.

X denotes a 4 pin base and metal shell. Y or Z denote octal bases but with different pin connections. (See Figures A to K.)

NOTE 4.

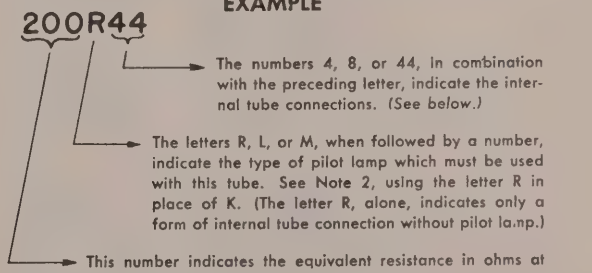
This number includes the drop in the series resistor plus the drop in the pilot lamp and its shunt. The number represents the difference between the sum of the heater voltages and the line voltage of 117.5 volts. Tubes are made with the following numbers: 98, 92, 86, 80, 73, 67, 61, 55, 49, 42, 36, 30, 23, 17, 11. The number to be used is the one closest to the voltage difference mentioned above.

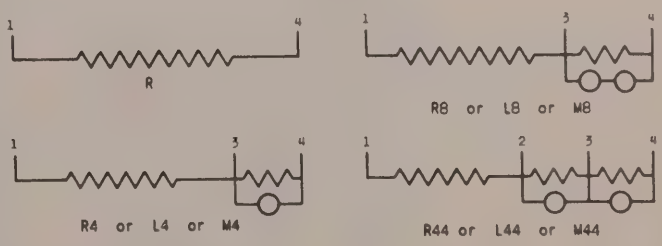



### SYSTEM B

All tubes under System B have glass bulbs and 4 pin bases and their type designations start with a number.

#### EXAMPLE

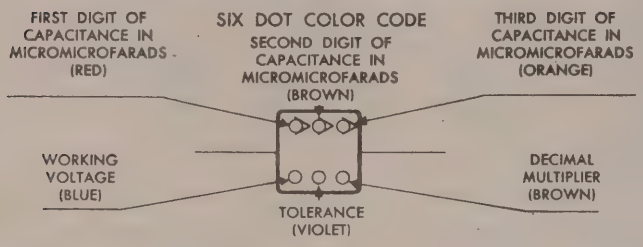

200R44
The numbers 4, 8, or 44, in combination with the preceding letter, indicate the internal tube connections. (See below.)
The letters R, L, or M, when followed by a number, indicate the type of pilot lamp which must be used with this tube. See Note 2, using the letter R in place of K. (The letter R, alone, indicates only a form of internal tube connection without pilot lamp.)
This number indicates the equivalent resistance in ohms at 0.3 ampere. Thus, 200 × 0.3 = 60 volts drop.




*Courtesy TUNG-SOL Lamp Works, Inc.*

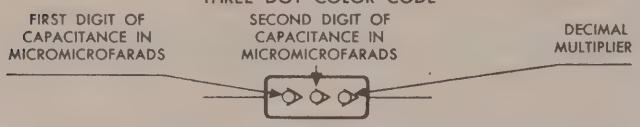
# RTMA CAPACITOR, RESISTOR, AND TRANSFORMER COLOR CODES

## CAPACITOR COLOR CODE


SIX DOT COLOR CODE
FIRST DIGIT OF CAPACITANCE IN MICROMICROFARADS - (RED)
SECOND DIGIT OF CAPACITANCE IN MICROMICROFARADS (BROWN)
THIRD DIGIT OF CAPACITANCE IN MICROMICROFARADS (ORANGE)
WORKING VOLTAGE (BLUE)
DECIMAL MULTIPLIER (BROWN)
TOLERANCE (VIOLET)

EXAMPLE: 2130 $\mu\mu f.$ $\pm 7\%$, 600 W.V. (Values for color shown in the above parenthesis)

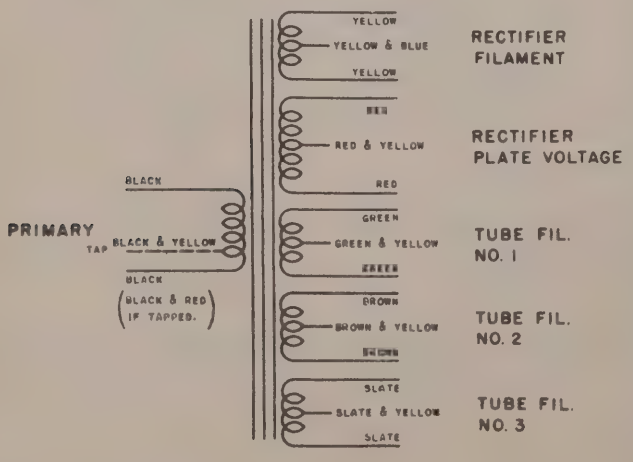
THREE DOT COLOR CODE


FIRST DIGIT OF CAPACITANCE IN MICROMICROFARADS
SECOND DIGIT OF CAPACITANCE IN MICROMICROFARADS
DECIMAL MULTIPLIER

| COLOR | DIGIT NUMERAL | DECIMAL MULTIPLIER | TOLERANCE | WORKING VOLTAGE |
|---|---|---|---|---|
| BLACK | 0 | 1 | 20% | — |
| BROWN | 1 | 10 | 1% | 100 |
| RED | 2 | 100 | 2% | 200 |
| ORANGE | 3 | 1000 | 3% | 300 |
| YELLOW | 4 | 10000 | 4% | 400 |
| GREEN | 5 | — | 5% | 500 |
| BLUE | 6 | — | 6% | 600 |
| VIOLET | 7 | — | 7% | 700 |
| GRAY | 8 | — | 8% | 800 |
| WHITE | 9 | — | 9% | 900 |
| GOLD | — | 0.1 | — | 1000 |
| SILVER | — | 0.01 | 10% | — |

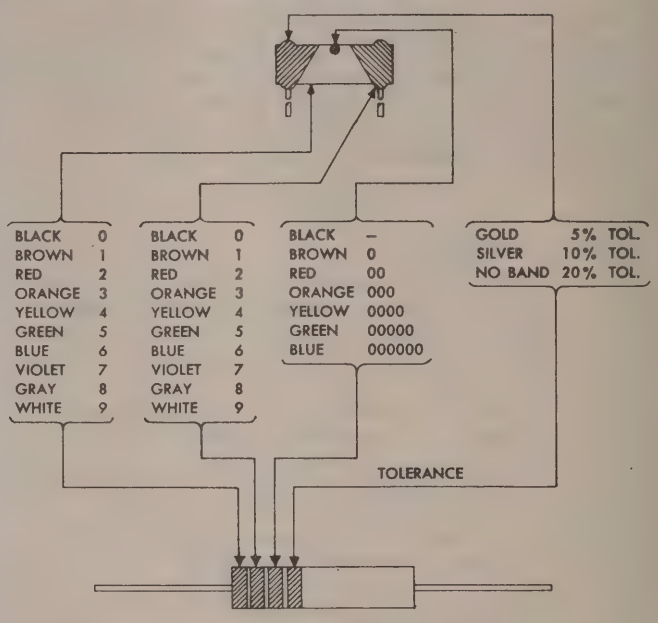
## POWER TRANSFORMER LEAD COLOR CODE

Power transformer leads in radio receivers may be identified by the following colors (or color patterns) on the lead coverings.




*Courtesy TUNG-SOL Lamp Works, Inc.*

## RESISTOR COLOR CODE




RESISTANCE VALUE: The nominal resistance value in ohms is identified by a three digit symbol. The first two digits are the first two figures of the resistance value in ohms. The third digit specifies the number of zeros which follow the first two figures.

## I-F TRANSFORMER LEAD COLOR CODE

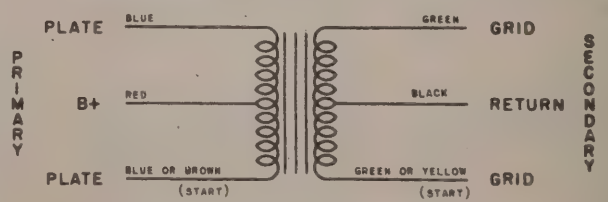
I-F transformer leads in radio receivers may be identified by the following colors on the lead coverings.

| | | | |
|---|---|---|---|
| PLATE LEAD | BLUE | GRID (or diode lead) | GREEN |
| B+ LEAD | RED | GRID RETURN | BLACK |

FOR "FULL-WAVE" TRANSFORMER SECOND DIODE LEAD WILL BE GREEN-BLACK.

## AUDIO TRANSFORMER LEAD COLOR CODE

Interstage and Output Audio Transformer leads in radio receivers may be identified by the colors on the lead coverings as shown.




In cases where use is made of a single primary and/or a single secondary, the upper half of the diagram indicates the color coding. The brown and yellow leads indicate the start of the primary and secondary windings respectively and will be used in place of the blue and green (as shown) where polarity indications are required.

PILOT LAMP TABLE

| Lamp No. | Volts | Amperes | Bead Color | Miniature Base | Bulb Type |
|---|---|---|---|---|---|
| 40 | 6-8 | 0.15 | Brown | Screw | T-3 1/4 |
| 41 | 2.5 | 0.50 | White | Screw | T-3 1/4 |
| 42 | 3.2 | 0.35 | Green | Screw | T-3 1/4 |
| 43 | 2.5 | 0.50 | White | Bayonet | T-3 1/4 |
| 44 | 6-8 | 0.25 | Blue | Bayonet | T-3 1/4 |
| 45 | 3.2 | 0.35 | White | Bayonet | T-3 1/4 |
| 46 | 6-8 | 0.25 | Blue | Screw | T-3 1/4 |
| 47 | 6-8 | 0.15 | Brown | Bayonet | T-3 1/4 |
| 48 | 2.0 | 0.06 | Pink | Screw | T-3 1/4 |
| 49 | 2.0 | 0.06 | Pink | Bayonet | T-3 1/4 |
| 50 | 6-8 | 0.20 | White | Screw | G-3 1/2 |
| 51 | 6-8 | 0.20 | White | Bayonet | G-3 1/2 |
| 55 | 6-8 | 0.40 | White | Bayonet | G-4 1/2 |
| 292 | 2.9 | 0.17 | White | Screw | T-3 1/4 |
| 292A | 2.9 | 0.17 | White | Bayonet | T-3 1/4 |
| 1455 | 18.0 | 0.25 | Brown | Screw | G-5 |
| 1455A | 18.0 | 0.25 | Brown | Bayonet | G-5 |
| 1490 | 3.2 | 0.16 | - - - | Bayonet | T-3 1/4 |

GERMANIUM CRYSTAL DIODE CHARACTERISTICS

| Germanium Crystal | Min. Forward Current at +1v (Ma) | Max. Reverse Current (Microamp.) | Peak Inverse Voltage (Volts) | Average Anode Rect. Current (Ma) | Peak Anode Rect. Current (Ma) |
|---|---|---|---|---|---|
| 1N34<br>1N34A | 5.0 | 50 at -10v<br>800 at -50v | 75 | 40 | 150 |
| 1N35* | 7.5 | 10 at -3v | 75 | 22.5 | 60 |
| 1N38<br>1N38A | 3.0 | 6 at -3v<br>625 at -100v | 120 | 40 | 150 |
| 1N39 | 3.0 | 200 at -100v<br>800 at -200v | 225 | 40 | 150 |
| 1N40** | 12.75 (at 1.5 volts) | 50 at -10v | 75 | 22.5 | 60 |
| 1N41** | 12.75 (at 1.5 volts) | 50 at -10v | 75 | 22.5 | 60 |
| 1N42** | 12.75 (at 1.5 volts) | 6 at -3v<br>625 at -100v | 120 | 22.5 | 60 |
| 1N48 | 4.0 | 833 at -50v | 85 | 50 | 150 |
| 1N51 | 2.5 | 1670 at -50v | 50 | 25 | 100 |
| 1N52 | 4.0 | 150 at -50v | 85 | 50 | 150 |
| 1N54<br>1N54A | 5.0 | 10 at -10v | 75 | 40 | 150 |
| 1N55<br>1N55A | 3.0 | 300 at -100v<br>800 at -150v | 170 | 40 | 150 |
| 1N56<br>1N56A | 15.0 | 300 at -30v | 50 | 50 | 200 |
| 1N57 | 4.0 | 500 at -75v | 90 | 40 | 150 |
| 1N58<br>1N58A | 4.0 | 800 at -100v | 115 | 40 | 150 |
| 1N60† | † | † | 70 | 40 | 150 |
| 1N63 | 4.0 | 50 at -50v | 125 | 50 | 150 |
| 1N64 | Tested for efficiency in 44 Mc video detector circuit. | | | | |
| 1N65 | 2.5 | 250 at -50v | 85 | 50 | 150 |
| 1N69‡ | 5.0 | 850 at -50v | 75 | 40 | 125 |
| 1N70‡ | 3.0 | 410 at -50v | 125 | 30 | 90 |
| 1N71†† | 15.0 | 300 at -30v | 50 | 50 | 200 |

NOTE: Crystals 1N48, 1N51, 1N52, 1N63, 1N64, and 1N65 are General Electric types, all others are Sylvania types unless otherwise indicated.

* Units are matched in the forward direction at +1 volt so that the current flowing through the higher resistance unit is within 10% of that in the lower resistance unit. Ratings shown are for each diode.

**Consists of 4 specially selected and matched germanium diodes whose resistances are balanced within ± 2.5% in the forward direction at 1.5 volts. For additional balance, the forward resistance of each pair of varistor crystals are matched within 3 ohms. Ratings shown above are for each diode.

† Units are tested in a circuit employing an input of 1.8 volts rms at 40 mc. 70% modulated at 400 cycles. Demodulated output across a 4700 ohm resistor shunted by a 5 mmf capacitor is a minimum of 1.1 volts peak to peak.

‡ JAN types

††Consists of four matched low impedance germanium diodes each of which, with a voltage of one volt impressed in the forward direction, will pass a current within one ma of the average current of the four. Ratings shown above are for each diode.

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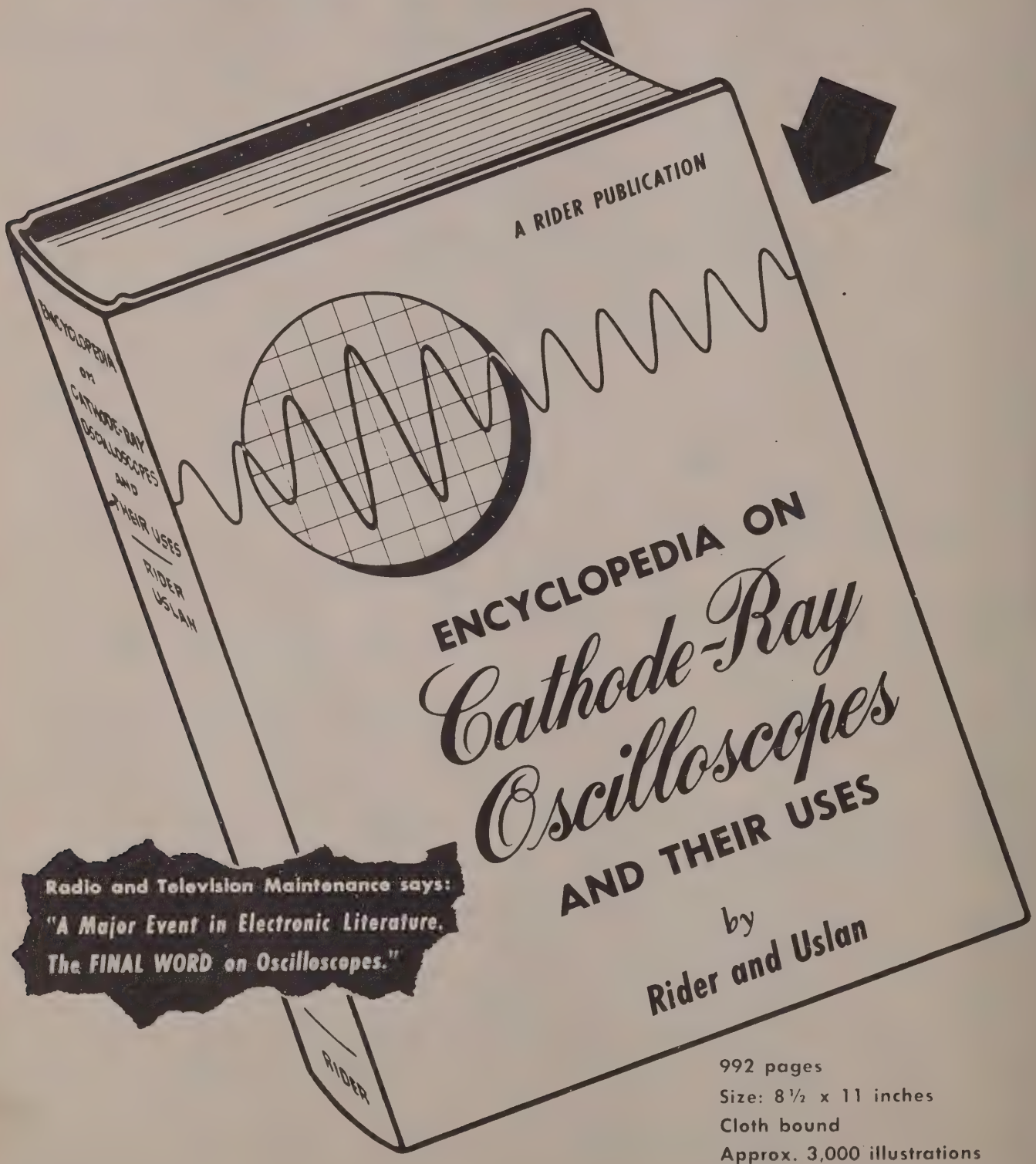


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**THE BASIC OSCILLOSCOPE**
- Sections of the Basic Oscilloscope
- The Cathode-Ray Tube
- The Beam-Positioning System
- The Vertical-Deflection Amplifier
- The Horizontal-Deflection Amplifier
- The Time-Base System
- The Synchronizing System
- The Intensity-Modulation System
- The Power Supply
- Panel Organization of the Controls
- Nomenclature of the Controls
- Horizontal-Amplifier Control Nomenclature

**FUNCTIONAL ORGANIZATION OF THE BASIC OSCILLOSCOPE**
- Direct Connection to Deflection Plates
- The Cathode-Ray Tube with Amplifiers
- Vertical Deflection Only
- Frequency Comparison
- Horizontal Deflection Only

**WAVEFORM PRESENTATION**
- Relationship Between Sweep and Signal Frequencies
- Integral and Fractional Sweep-Signal Frequency Ratios
- Keeping the Pattern Stationary (The Synchronizing Control)
- Variables in Waveform Display
- Vertical Amplitude Variations
- Insufficient and Excessive Synchronization
- Sweep Frequency Higher Than Signal Frequency
- Distortion of Complex Wave Input
- Sweep Frequency for Complex Waves
- External Synchronization of Sawtooth Oscillator
- 60-cps or Line Synchronization of Sawtooth Oscillator
- Distortion Due to Nonlinear Sweep
- Summary of Waveform Display
- Sine-Wave Time Base Presentation

**FACTORS CONTROLLING APPLICATION OF THE BASIC OSCILLOSCOPE**
- Frequency as a Controlling Factor
- Impedance of Deflection-Plate System
- Low-Frequency Response of Cathode-Ray Tube
- Operation Features of Vertical Amplifiers
- Required Amplifier Gain
- Frequency Requirements of Vertical Amplifiers
- Importance of Harmonics
- Pulse Duration and Rise Time
- Bandwidth in Television Oscilloscopes
- Composition of a Sawtooth Wave
- Frequency Bandwidth for Sawtooth Waves
- Phase or Time Delay in Amplifiers
- The Behavior of Vertical-Amplifier Attenuators
- Frequency-Response Curves
- Limits of Bandwidth
- Basis of Wide-Band Response
- Frequency-Compensation Methods
- The Advantage of Wide-Bandwidth Amplifiers

**CIRCUIT FEATURES OF VERTICAL AMPLIFIERS**
- A-C and D-C Amplifiers
- The Direct-Coupled (D-C) Amplifier
- Practical D-C Amplifiers
- D-C Coupling and Square Wave Amplification
- Phase Inverters and Push-Pull Systems
- Advantages of Push-Pull Amplification
- Phase Relationship Between Input and Output Signals
- Cathode-Follower Input System Circuits
- Input Probes and Attenuating Cables

**CIRCUIT FEATURES OF THE HORIZONTAL AMPLIFIER**
- Horizontal Amplifier Bandwidth
- Horizontal Amplifier Input Impedance
- X vs. Y Amplifier Circuits
- The Horizontal Gain Control and Sweep Amplitude

**THE TIME-BASE GENERATOR (REPETITIVE SWEEP)**
- Visibility of the Retrace
- Blanking of the Retrace
- Markers by Blanking
- Markers by Intensity Modulation
- Triggered Sweeps
- The Delay Circuit
- Sweep Speed
- Sweep Calibrator
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- Power-Supply Input Voltage
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- Component Parts of Power Supplies
- The Half-Wave Rectifier
- The Full-Wave Rectifier
- Filter Systems
- The Voltage Divider
- Voltage Regulators
- Multibeam Oscilloscopes

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Chapter 4 — Mechanical Characteristics
Chapter 5 — The Electron Gun
Chapter 6 — Deflection Systems
Chapter 7 — Screens
Chapter 8 — Spot Displacement
Chapter 9 — Linear Time Bases (Sweep Circuit)
Chapter 10 — The Basic Oscilloscope and Its Modifications
Chapter 11 — Synchronization
Chapter 12 — Phase and Frequency Measurements
Chapter 13 — Nonlinear Time Bases
Chapter 14 — Auxiliary Equipment
Chapter 15 — Testing Audio Frequency Circuits
Chapter 16 — Visual Alignment of AM, FM, and TV Receivers
Chapter 17 — Waveform Observation in Television Receivers
Chapter 18 — AM, FM, and TV Transmitter Testing
Chapter 19 — Electrical Measurements and Scientific and Engineering Applications
Chapter 20 — Complex Waveform Patterns
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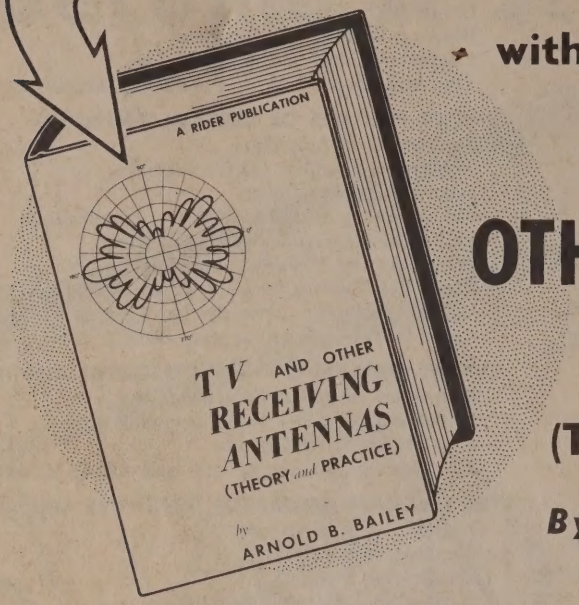


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